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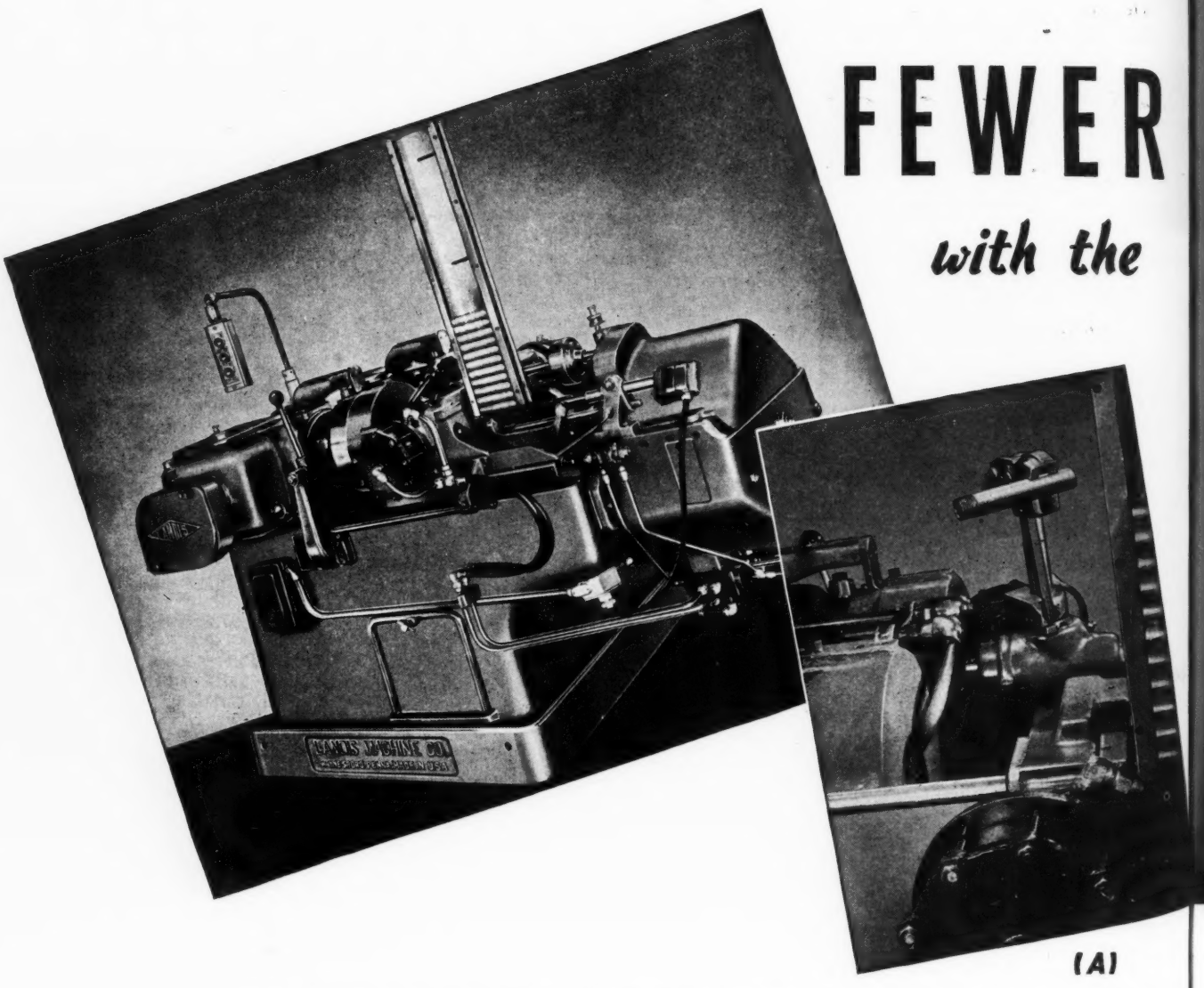

(A)

• NEW TRANSFER MECHANISM ALLOWS LONGER

The operation cycle of the Landis Automatic Nipple Machine is completely automatic. During operation, the operator is only required to give the machine visual attention and keep the magazine on the left-hand carriage filled with nipple blanks.

The nipple blanks are released automatically from the magazine by the forward movement of the carriage. After being pushed into position in the grips, they are held by the closing of the air-operated vise. The left-hand carriage advances rapidly to the thread-starting position, and then assumes a feed rate of travel equal to the lead of the thread being cut. An accurately-machined cam controls the entire carriage movement.

After the thread has been cut, and the reaming and chamfering operations simultaneously completed on one end of the nipple blank, the die head and vise open automatically and the carriage returns to loading position. The semi-finished nipple is left in position on the work-rest bar for transfer to the right-hand carriage. Mechanical fingers pick up the semi-finished

LANDIS MACHINE

MACHINERY
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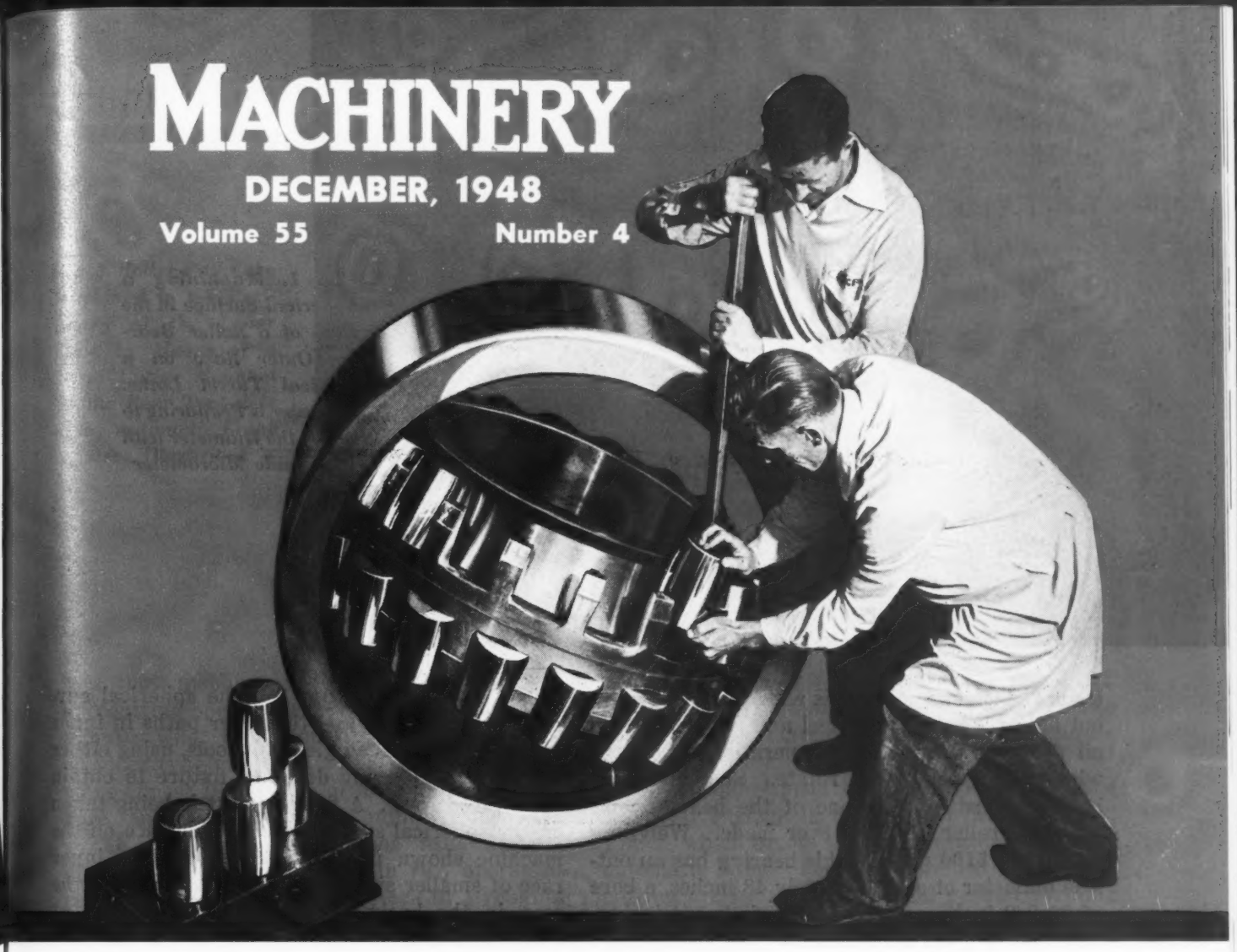
Volume 55 Number 4



Huge Spherical Roller Bearings Made to Close Tolerances

Spherical Roller Bearings as Large as 48 Inches in Diameter and Weighing More than 5100 Pounds are Manufactured with Tool-Room Precision at SKF Industries, Inc., Philadelphia. Up to 5/32 Inch of Stock Must be Ground from the Surfaces of the Machined Rings

By CHARLES H. WICK

THE current demand for anti-friction bearings is from two to five times prewar levels. To meet this increased demand, SKF Industries, Inc., is spending $4,000,000 dollars on expanding and modernizing its two Philadelphia plants, and a substantial portion of this program is aimed at increasing the output of spherical roller bearings. Some of the new machines employed to produce the bearings are capable of operating two to six times faster than the standard equipment long used in the anti-friction bearing industry.

The spherical roller type of self-aligning bearing, which is capable of withstanding high shock

Fig. 1. Machining a Spherical Surface in the Bore of a Roller Bearing Outer Race on a Vertical Turret Lathe. Operator is Preparing to Check the Diameter with an Inside Micrometer

loads and two-way thrust, is widely used throughout heavy industry—in steel and paper mills, in oil fields, and in mining operations; in fact, wherever large shafts rotate. Shown in the heading illustration is one of the heaviest size spherical roller bearings ever made. Weighing more than 5100 pounds, this bearing has an outside diameter of approximately 48 inches, a bore of 26 3/8 inches, and a width of 17 1/4 inches. Each bearing has a basic load rating of 4,250,000 pounds when its inner race is rotating at low speed.

Inner and outer races for spherical roller bearings are machined from forgings of S K F No. 2 steel, a modification of S A E 52100. Forgings larger than 26 inches outside diameter are turned and faced on Bullard vertical turret lathes as shown in Fig. 1. The spherical surface in outer races and the roller paths in inner races are cut with single-point tools, using either a cam or a specially designed fixture to obtain the desired form. A finishing cut is being taken on the spherical surface of an outer race on the machine shown in the foreground. An inner race of smaller size is being turned on the lathe seen in the background of the illustration at the right.

Medium-sized forgings are machined on 16-inch Fay automatic lathes (Figs. 2 and 3) adapted for the use of carbide-tipped tools by the installation of motors having twice the horsepower previously employed. New 28-inch Fay automatics—the largest ever made—were installed this year. Operated by 100-H.P. mo-

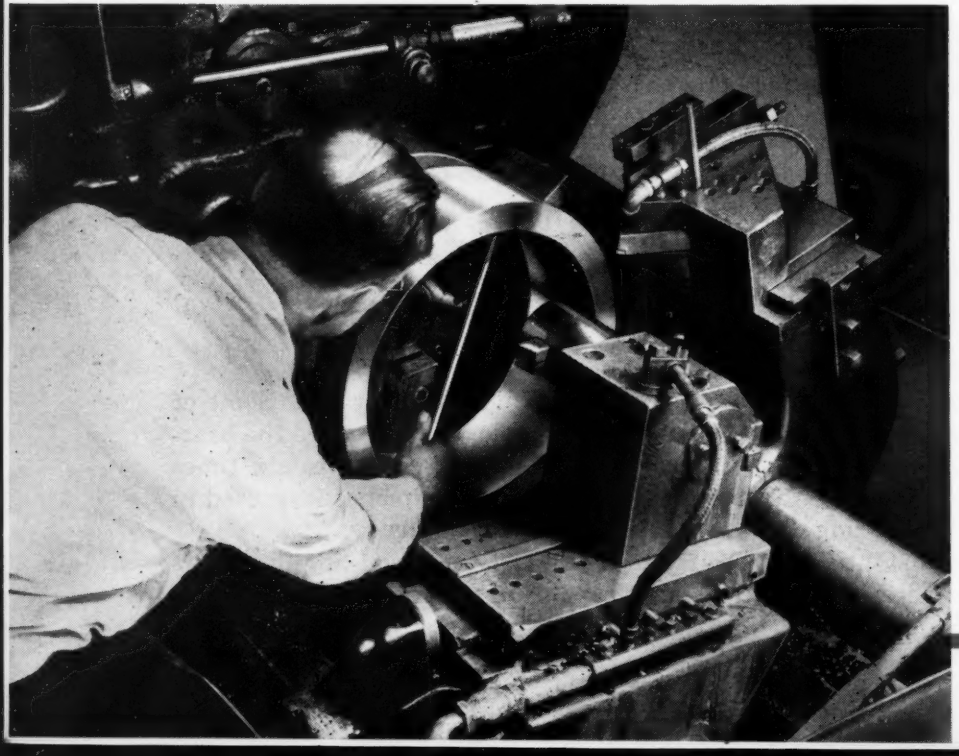


Fig. 2. The Spherical Surface of Small Outer Races is Produced in a Roughing and Finishing Operation on Automatic Lathes Equipped with Former Bars

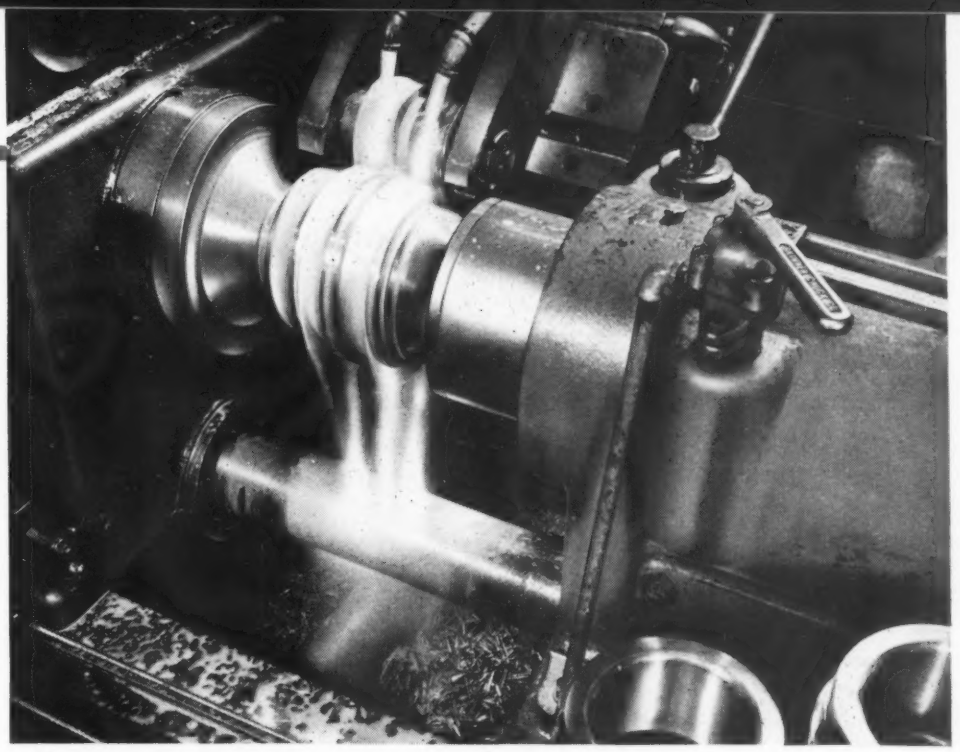


Fig. 3. Roller Paths are Machined in the Periphery of the Inner Race by Means of a Form Cutter Mounted on the Rear Tool-slide of the Automatic Lathe Here Illustrated

tors, these machines will permit the use of feeds and cutting speeds that will accomplish in eight minutes what was formerly done in two hours on older type machines. The new machines remove almost 100 pounds of metal from a 16-inch bore inner ring in an eight-minute cycle.

The spherical surface on the inside diameter of outer races is machined in two operations, removing about 5/8 inch of stock in a roughing operation on one lathe and approximately 1/16 inch in a finishing operation on a second machine, depending on the size and type of forging. Roughing operations are performed with the pneumatically or hydraulically chucked work rotating at 210 surface feet per minute and a tool feed of 0.024 inch per revolution. For finishing, a surface speed of 250 feet per minute and a feed of 0.033 inch per revolution is employed. With the new automatic lathes, however, these speeds can be increased to 300 feet per minute and more.

The carbide-tipped tool used to machine the spherical surface is mounted on a boring-bar, Fig. 2, which pivots about the center bar of the automatic lathe. The tool is guided through its cutting arc by a hardened and ground forming block mounted on the front of the machine. Longitudinal feed of the tool is obtained by cams bolted to the cam drum on the rear of the machine. During the time that the spherical surface is being cut, a facing tool that pivots about the rear bar of the machine is completing its travel across one side of the part.

Inner races are bored, faced, grooved, and

Fig. 4. Surface Grinding Face of a Spherical Bearing Race, which is Mounted on a Magnetic Chuck beneath a Segmental Grinding Wheel

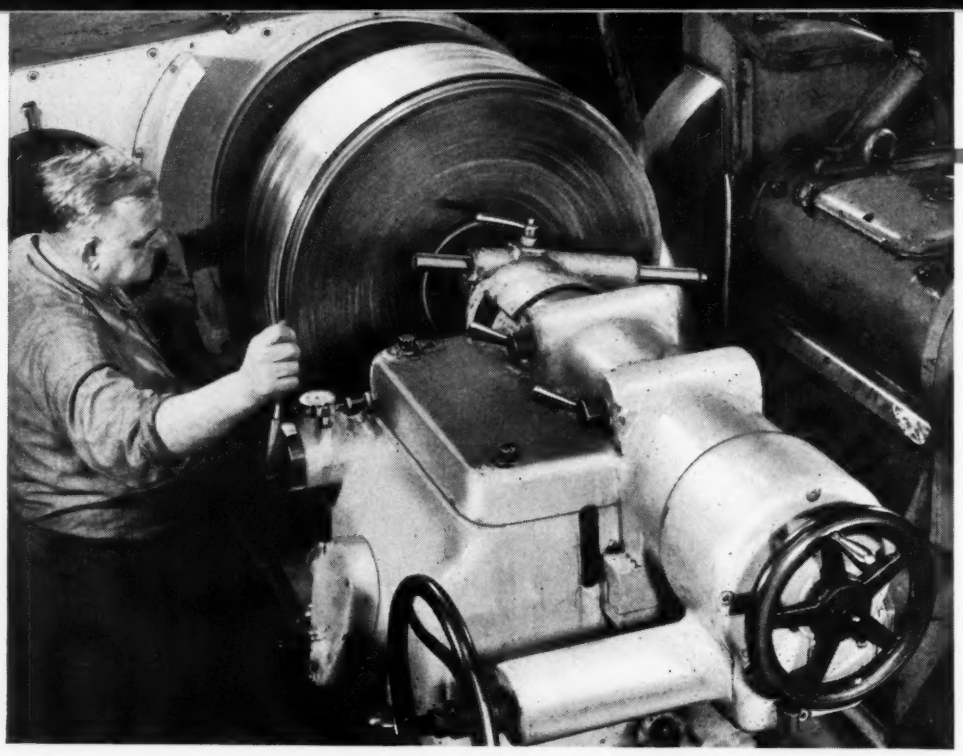


Fig. 5. Outside Diameter of Large Outer Races is Ground on a Huge Cylindrical Grinder, Removing up to 5/32 Inch of Stock

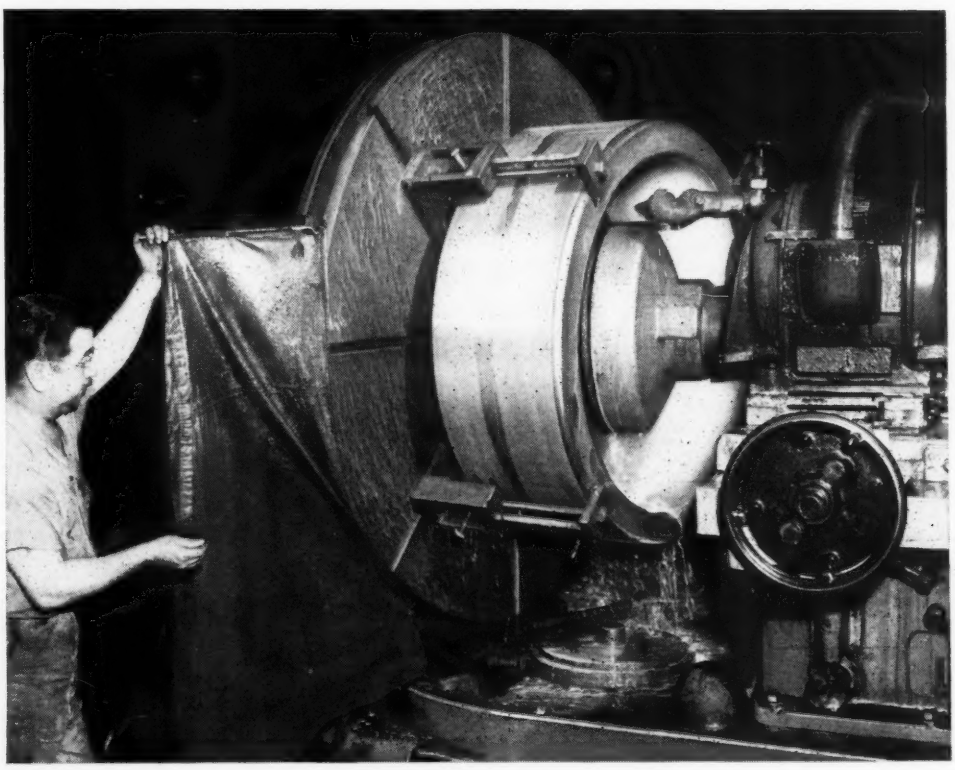


Fig. 6. Up to 1/8 Inch of Stock is Removed from the Spherical Surface in the Bore of the Outer Races on This Special Grinder

turned in three operations on separate automatic lathes. In the first operation, the ring is rough-bored on the in stroke of the tool and finish-bored on the return stroke while another carbide-tipped tool is taking a facing cut on one end of the work. The second operation consists of turning three diameters and facing the other end of the work, the four tools cutting simultaneously. The pair of grooves or roller paths are then machined in the periphery of this ring by means of a high-speed steel form cutter, Fig. 3. The high-speed steel cutters are being rapidly replaced by tungsten-carbide tools for this operation. The largest bearing size inner races, which cannot be handled on the Fay lathes, have the roller paths machined on Bullard vertical boring mills, using single-point tools and suitable camming.

Extreme care must be taken in heat-treating such large-diameter, thin-walled rings. A care-

fully controlled method of heat-treatment stabilizes the rings against growth. Rings are machined with due allowance for dimensional changes caused by heat-treating. The heating time varies with the size of the work. The rings are heated in butane gas-fired, roller-hearth furnaces. The large races for the bearing shown in the heading illustration were heated for a total of seven hours at 1475 degrees F. An immediate oil quench is effected by quickly pulling the heated ring onto a vertical elevator and plunging it into an agitated oil bath. The time that the race remains in the oil bath is carefully controlled, and the work is removed while still warm to minimize the danger of cracking. The work is then tempered for four hours at controlled temperatures in order to give a Rockwell hardness of 59 minimum.

Both inner and outer races of spherical roller bearings have their side faces ground. For grinding 48-inch diameter outer races, the column and water guards of a large Blanchard surface grinder are extended and a 52-inch diameter plate is placed on top of the 42-inch magnetic chuck of the machine. The work, held magnetically on the plate, is rotated at 13 R.P.M., and the 20-inch diameter wheel, made up of eight segments, is revolved at 720 R.P.M. by a 35-H.P. motor on the vertical wheel-spindle.

A total of approximately 0.065 inch of stock is removed from these large rings in three operations, turning the ring over between each grind. The desired width is maintained within 0.0015 inch, faces are kept parallel within 0.001 inch, and surface irregularities are held to not more than 0.00004 inch, peak to valley. Medium-sized races—up to 42 inches in diameter—are also ground singly on machines of the type mentioned by being mounted directly on the magnetic chuck, as seen in Fig. 4.

Small rings are ground on a Gardner double-wheel grinder, in which both sides of the ring are ground simultaneously. Resinoid-bonded aluminum-oxide abrasive segments of 46 grain size and H grade are employed. Small rings are demagnetized on the machine and on a belt conveyor leading from the machine. Large rings are removed to a bench for demagnetization.

The outside diameter of outer races is ground on the specially built Norton plain cylindrical grinder seen in Fig. 5. This modified roll grinder, with over-size spindles, has permitted increases in production up to 600 per cent. Arbors with adjustable end plates support the races, which may be ground singly, as shown, or in pairs. Prior to grinding, the races are tapped into alignment, using a dial indicator to insure concentricity.

The arbor supporting the work is held between centers. The work-head has a rheostat control for varying the speed. Large rings are rotated at about 12 R.P.M., and smaller rings at 18 R.P.M. Owing to unavoidable hardening distortion and work expansion, a considerable amount of stock is removed from the race, using a 54-grit aluminum-oxide wheel, 30 inches in diameter by 6 inches wide. The vitrified-bond, grade J wheel is rotated at 820 R.P.M. The work

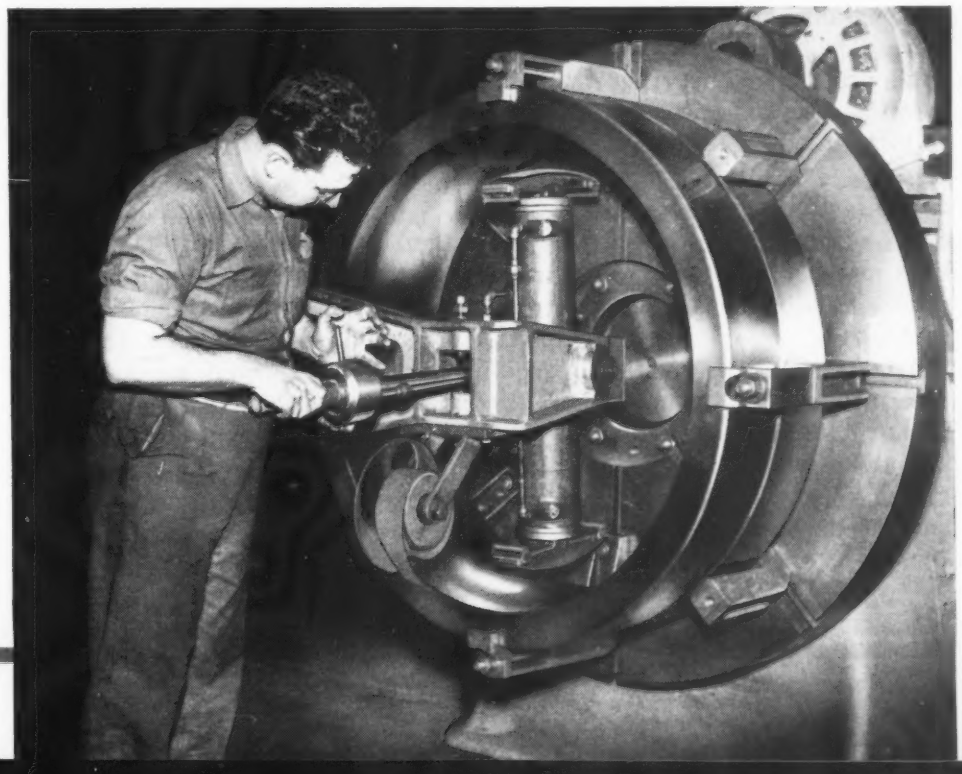


Fig. 7. The Spherical Surface in the Bore of the Outer Races is Polished on a Special Machine Equipped with Air-actuated Tongs

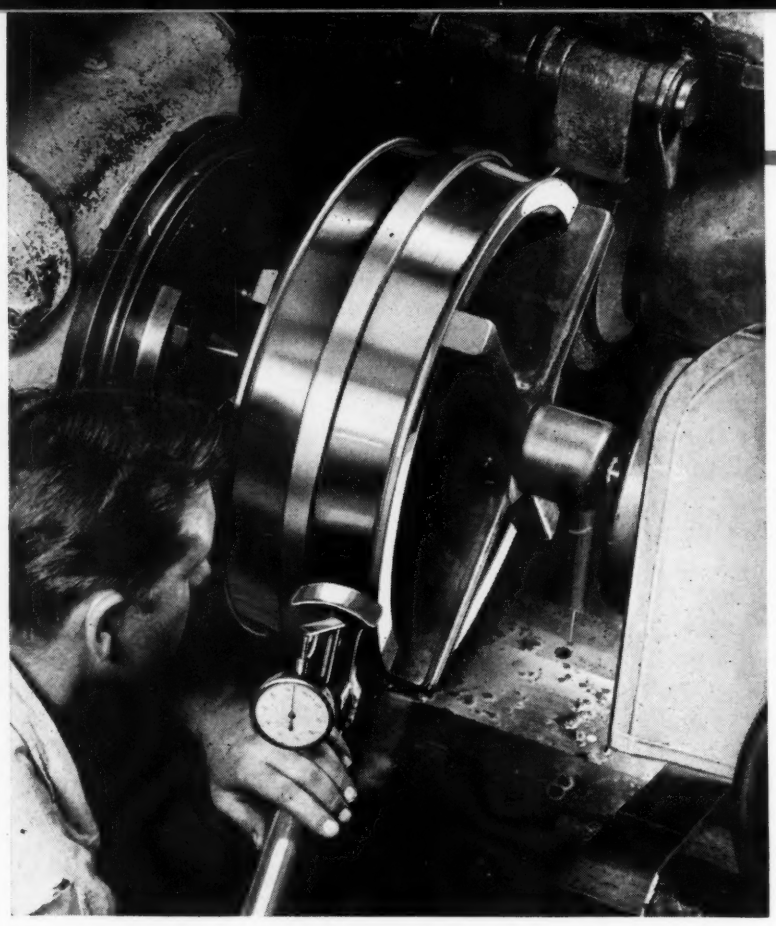


Fig. 8. Inner Races are Rotated at 32 R.P.M. and Oscillated 2 1/2 Times per Minute in the Groove-grinding Operation Illustrated

is traversed mechanically past the wheel at the rate of 8 strokes per minute. Size is held within 0.002 inch, roundness within 0.001 inch, and squareness of outside diameter with faces within 0.001 inch. Two wheel-dressers are employed, one located on the footstock for rough dressing, and the other—a hydraulic dresser—mounted on the wheel-head for finishing. A special handling device is used to mount the work on the arbor and the assembly on the machine.

The bores of inner races having an outside diameter of not more than 26 inches are ground on Heald internal centerless grinders, insuring concentricity of the bore with the outside diameter. The ring to be ground is placed within three rolls. The supporting roll is fixed, but free to rotate below the work, while the top pressure roll, mounted on a swinging bracket, holds the work in contact with the supporting roll and the driving roll.

A 54-grit grinding wheel, 8 inches in diameter by 4 inches wide, is used for this operation. It rotates at 3200 R.P.M., bearing against the inner surface of the work directly opposite the line of contact of the work with the driving roll and thus insuring rigid support. Grinding wheel and work rotate in the same direction. About 0.083 inch of stock is removed from the bores of these rings. The wheel is reciprocated through the bore at the rate of 12 strokes per minute.

The bores of large rings—up to 40 inches in diameter—are ground on plain internal grinding machines equipped with a faceplate and four jaws to grip the work. Bore size and squareness with the faces of the rings are held to within 0.002 inch.

The spherical surface in the bore of the outer race is ground on the special S K F-designed machine shown in Fig. 6. A hydraulically actuated table mechanism oscillates the 32-inch diameter by 6-inch wide grinding wheel, which rotates at 720 R.P.M. The work, which is clamped to a 6-foot diameter faceplate mounted on the work-head, is revolved at 22 R.P.M., but does not oscillate. Approximately 0.080 inch of stock is removed from the spherical surface in this operation.

The grinding wheel is lightly crowned by hand at the start of the opertion, and is then self-dressed by its 3 1/2 oscillations per minute through an arc which forms part of a perfect circle. The spherical surface is held to size within 0.004 inch and to a maximum eccentricity of 0.002 inch. The radius of the spherical surface is maintained within a maximum of 0.0004 inch, but is generally practically perfect. The spherical surface is inspected with a ring gage and Prussian blue or with a chord-measuring dial indicator.

The two roller paths or grooves in the outside diameter of the inner races and their flange surfaces are ground on another S K F-built machine, Fig. 8. In this machine, the work is rotated at 32 R.P.M. and oscillated 2 1/2 times per minute past the grinding wheel. The 18-inch diameter by 5/8-inch wide grinding wheel is revolved at 1350 R.P.M. and fed into the work. The grooves are held within 0.002 inch of the required size, 0.001 inch for roundness, and 0.002 inch for eccentricity with the bore.

During actual operation of the bearing, the ends of the barrel-shaped rollers contact the center flange only, and not the outer flanges of the inner race. This center flange is held to size

Fig. 9. The Bodies of Spherical Rollers are Ground by Mounting Them between Centers as Shown. The Work-holding Fixture Oscillates about the Grinding Wheel

within 0.002 inch. The radius of the concave faces that mate with the convex ends of the rollers is maintained within 0.0002 inch of the specified dimension.

After a 100 per cent etch to indicate surface defects, the roller paths of both inner and outer races are polished, as shown in Fig. 7. In the polishing machine, air-actuated tongs carry an abrasive strip, which is fed across supporting rolls. The work is rotated at 126 R.P.M. while the tongs carrying the abrasive strip are manually oscillated over the surface to be polished. The 60-grit cloth-back abrasive strip, to which is applied a wet polishing compound of 180 grit, removes about 0.001 inch of stock from each surface. Polishing pressure can be varied by changing the pressure supplied to the air cylinder that actuates the tongs.

The barrel-shaped rollers are made from bar stock of the same material as the races. Large-sized rollers are turned on four-spindle automatic screw machines, while the smaller sized ones are cold-headed in two-stage dies on forging presses. Medium-sized rollers are produced in a two-stage die mounted on a "Maxipres" weighing 60 tons. The left-hand die forms the rounded corners and a center (for subsequent grinding) on one end of the slug. After manually transferring the partially formed roller to the right-hand die, the barrel shape is forged on the next stroke of the press ram. The small amount of flash formed at the mating line of upper and lower dies is removed by tumbling.

After hardening, the large-diameter ends of the rollers are ground to a convex shape and the opposite ends to a concave shape. These two operations are performed on specially built S K F machines, each equipped with two magnetic chucks for holding the rollers. The chucks are rotated at about 700 R.P.M., while the grinding wheel is revolved at 1800 R.P.M.

The bodies of the rollers are ground on machines in which the work is held horizontally by means of a cup at one end and a spring-loaded, lever-actuated plunger at the other end (Fig. 9). The work-holding fixture oscillates about the grinding wheel. The size is held within 0.001 inch, and the rollers are grouped by size for selective assembly to within 0.0001 inch.

The roller retainers or cages are made from centrifugally cast brass tubing. The work is placed on an angular index-plate mounted on the table of a Natco automatic single-spindle drilling machine. The roller pockets are drilled and reamed in two operations at the same set-up. The tools are rotated at 280 surface feet per minute, and fed hydraulically into the work at the rate of 0.005 inch per revolution.

The first step in assembling any spherical roller bearing is to place the cage or retainer in its proper position on the inner race. Then the cage is rotated, lining up each roller pocket with a filling notch provided in the inner race. This permits all but three or four rollers to be inserted in each row. The number of rollers omitted in this partial assembly may vary, depending on the size and width of the bearing being assembled. The empty roller pockets are equally divided on two sides of the cage, diametrically opposite each other. The inner race and partial roller assembly can now be handled without fear of the rollers dropping out of their cage pockets. One row of rollers is revolved so that the vacant pockets in both rows will be in line with each other.

As the diameter across the cage at these missing roller locations is smaller than the outer race

spherical opening, it is possible, by turning the inner race at right angles to the outer race, to insert the inner assembly into the outer race. Once assembled, the cage is revolved to allow the rollers to make contact with the outer-race roller path. With the inner assembly still in a 90-degree misaligned position, the missing rollers in both rows are inserted. The bearing can then be swiveled into position.

Bearings that pass all final inspections are dried in an infra-red oven to eliminate moisture, slushed in heavy oil, and protected by several layers of wrappings. The bearings are then ready for shipment or storage.

High-Speed Boring and Turning Operations

NINE hundred hydraulic tappet tubes are machined externally and internally per hour in a New Britain precision boring and turning machine equipped with magazines that automatically feed the work-pieces to the two heads. As shown in Fig. 1, the magazines consist of two vertical tubes provided with a slot at the upper end which is so machined that the tappet tubes can only be slipped right side up into the magazine tubes.

At the lower end of the magazine tubes, the tappet tubes are transferred to the collets on the work-spindles by means of air-actuated loading pins which enter the hole in the tappet tubes and index them to a horizontal position. These loading pins are mounted in ball bearings, so that they are free to turn with the work-pieces when the latter are inserted in the collet chucks. The chucks run at 6000 R.P.M.

After the work-pieces have been loaded in the chucks, the latter are closed automatically and the loading pins are withdrawn. Then, as the table advances the tool-slide to the work, the tappet tubes are turned, chamfered at one end, bored straight, as well as to a ball-seat radius, and faced. At the end of the machining operations, the collets are opened automatically and the work-pieces are ejected by cam-actuated rods. The swinging hood seen beneath the spindles catches the parts and drops them into a chute. A blast of air blows the parts down the chute to a tote pan.

Two parts are produced every eight seconds, and the carbide tools have a life in excess of 1000 pieces between grinds. Tappet tubes varying in length from 5/8 to 1 1/4 inches can be handled without any tooling or magazine change. All tubes are 11/32 inch in diameter.

In applying the various tools in operations of this type, the slide and table of the machine are

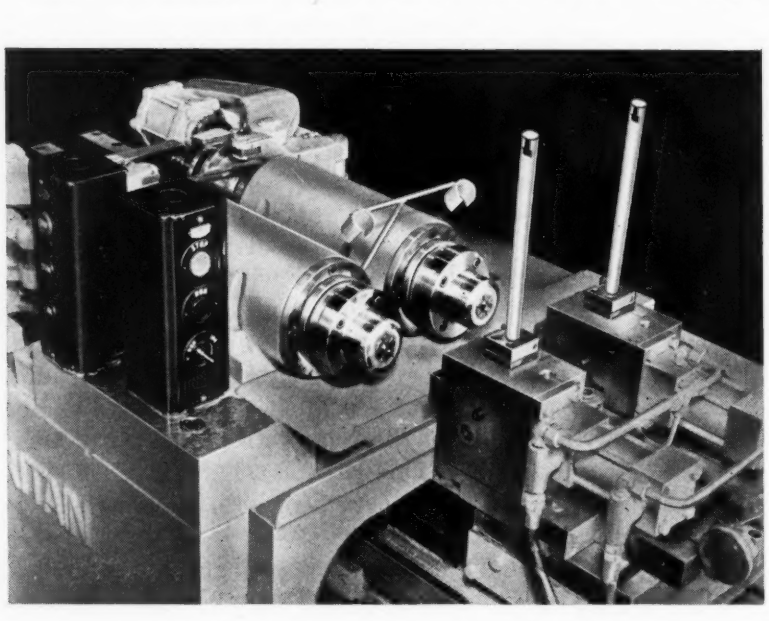


Fig. 1. Precision Boring and Turning Machine Equipped with Tubular Magazines for the Automatic Feeding of Short Tappet Tubes

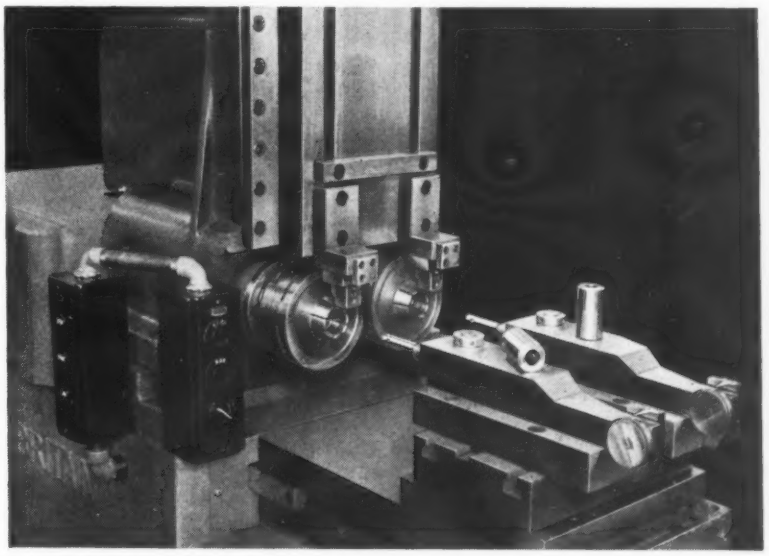


Fig. 2. A Vertical Tool-slide on This Precision Boring and Turning Machine Enables Facing Cuts to be Taken Simultaneously with Boring and Turning Cuts

actuated directly by cams. The transfer arms are remotely controlled through cam-operated air valves.

Vertical Tool-Slide Used for Operations on Dynaflow Gear Blanks

The use of a vertical tool-slide on a New Britain precision boring and turning machine for facing cuts greatly reduces the production time in an operation on low-speed pinion blanks for Buick Dynaflow transmissions. The vertical slide operates simultaneously with the horizontal tool-slide and table, so that the total machining time in an operation such as illustrated in Fig. 2, for example, is held to the time required for boring alone.

The purpose of the operation is to provide a hole in the pinion blank that is accurate as to diameter and concentricity, for locating the blank with precision in a subsequent tooth-hobbing operation. In the boring and turning operation, each work-piece is first inserted in the double-diaphragm chuck of the front spindle and then the slides are actuated. The hole in the pinion blank is semi-finish-bored during both the in and the out strokes of the tools, and a chamfer is plunge-cut around the hole. These cuts are, of course, taken by tools mounted on the horizontal slide. The part is faced, step-faced, and chamfered at the outer edge by tools mounted on the vertical slide. At the end of this cycle, the operator removes the part from the front spindle, reverses it, and places it in the double-diaphragm chuck of the rear spindle. Here the same cuts are taken on the opposite end of the piece.

The vertical slide is tilted forward slightly, so that the faces of the work are machined concave. This facilitates honing the faces flat after boring. Eighty-five pieces are machined per hour, which means a production rate of one piece every forty-two seconds. Carbide boring tools are employed for these operations.

Inert-Arc Welding of Hard-to-Weld Metals

Amount and Kind of Inert Gas, Type of Polarity and Current, and Welding Circuits Best Suited for Joining Such Hard-to-Weld Metals as Stainless Steel, Aluminum, and Magnesium

By M. J. CONWAY
Welding Equipment Divisions
General Electric Co.
Schenectady, N. Y.

THE inert-arc welding process can be used to join any clean non-volatile metal because the welding arc and the fused metal are protected by a shield of inert gas—usually argon or helium—that prevents oxidation of either the molten metal or the electrode. Thus, if a metal does not volatilize when fused, and thereby contaminate the inert-gas shield, it can be welded by this process.

For example, fully killed steel fuses quietly, and is readily welded by the inert-arc process. Aluminum, beryllium copper, brass, copper, Everdur, Fernico, Hastelloy C, Inconel, lead, magnesium, Monel, molybdenum, nickel alloys, phosphor-bronze, silicon steel, stainless steel, tantalum, and tungsten also can be joined. However, some materials, such as rimmed steel, may give off gas excessively and a porous weld results. Zinc and high-zinc alloys are examples of other materials that are difficult to weld by the use of the inert-arc process.

How Current and Polarity Affect the Weld

A cross-sectional drawing of a typical inert-arc electrode-holder is shown in Fig. 1. It is somewhat similar to the ordinary welding electrode-holder except that inert gas flows through it, surrounding the electrode, the arc, and that portion of the work being welded. In addition, the holder is water-cooled if the welding current equals or exceeds 100 amperes. This keeps the handle at a comfortable temperature, and also permits making the holder smaller than would otherwise be possible.

When direct current is used and the operator has the welding machine set for straight polarity, the tungsten electrode is negative and the work is positive. The current electrons that form the arc (along with argon ions) flow from the electrode to the work, as shown in Fig. 2. With straight polarity, these electrons hit the work and raise it to fusion temperature. The electrode runs comparatively cool. The greater part of the heat goes into the work, melting it rapidly.

The arc conditions that exist when direct current, reverse polarity, is used are seen at the right in Fig. 2. Here the current electrons flow from the work and strike the electrode. The electrode runs very hot, and tends to melt at even low welding currents. The work stays comparatively cool and little penetration or fusion occurs.

With reverse-polarity direct current, the electrons tear apart the oxide layer that is present on such metals as aluminum, beryllium copper, and magnesium when they break out of the work. Observation of completed welds in these materials indicates that the oxide layer is dis-

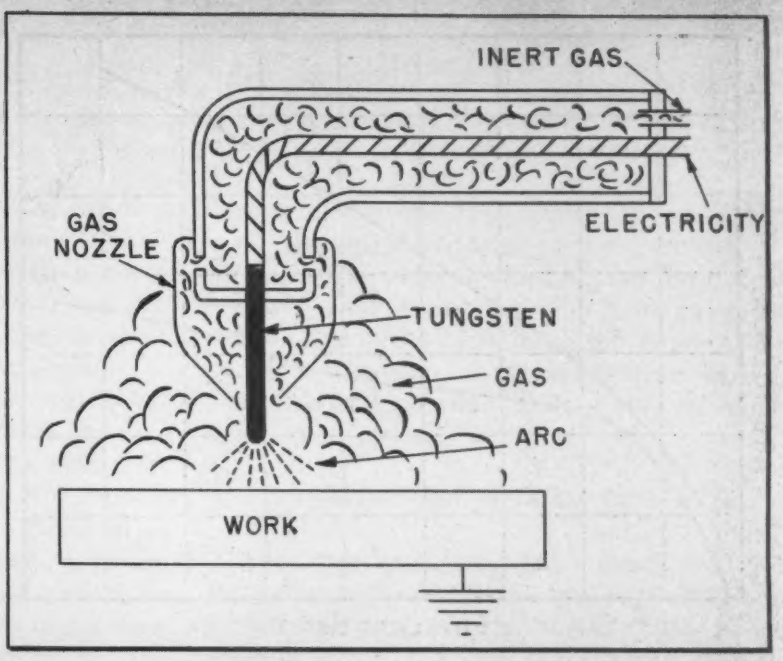
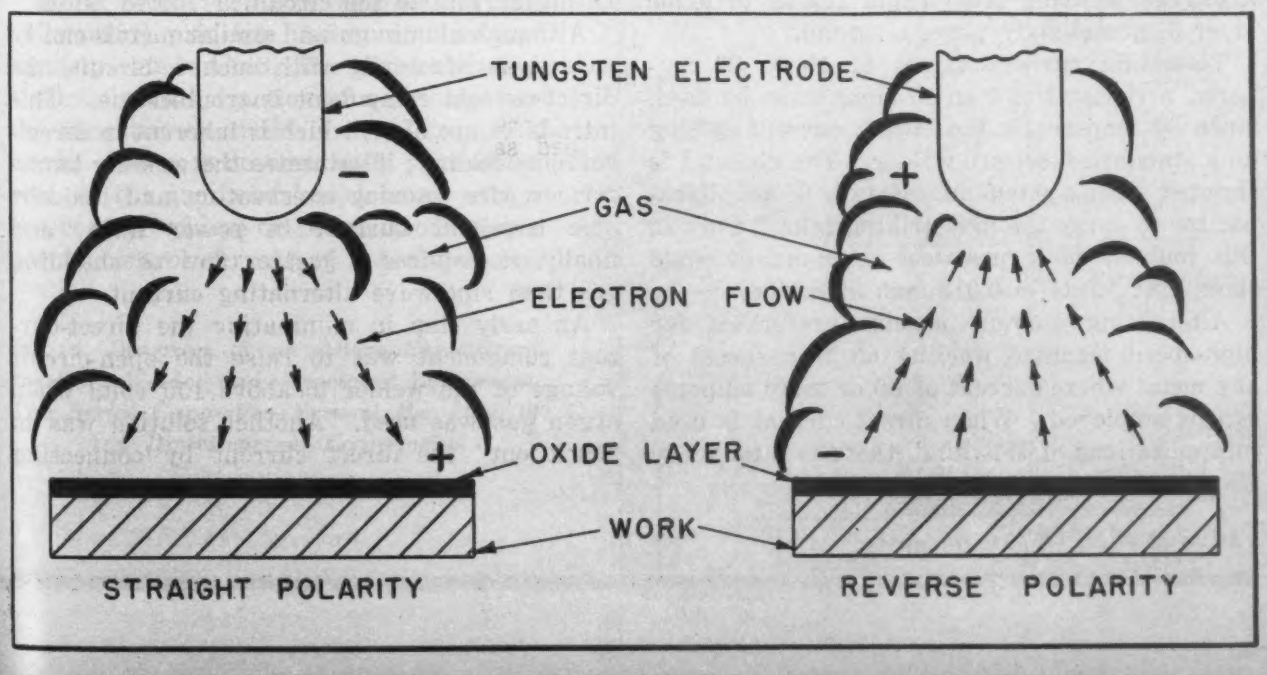


Fig. 1. An Inert-arc Electrode-holder is Similar to an Ordinary Welding Electrode-holder except that Provision is Made for the Inert Gas to Flow around the Electrode. Also, in Some Cases, the Holder is Water-cooled

persed to the edge of the weld bead by the arc action. This allows the molten metal to flow together, and a bright weld bead results; flux is not needed. Thus, a reverse-polarity circuit is better for welding some light metals than a straight-polarity circuit, which does not break up the oxide layer, but it is not as satisfactory as alternating current. When direct current is used for materials of this sort, it is necessary to hold an extremely short arc in order to obtain arc stability.

However, since the heat input to the work largely determines the welding speed, and the greatest heat input is obtained with straight-polarity, direct-current power, it stands to reason that this is the fastest process. The heat input also depends on the welding watts—that is, the welding current multiplied by the arc voltage. Because the arc voltage is higher with helium than with argon, as shown in Fig. 3, more watts are produced for a given welding current. Another advantage of helium is that the arc voltage increases directly with the arc length. It is known that this is usual in metallic arc welding, but does not happen to any considerable extent with an argon-gas shield. So it is that, in the majority of cases, a straight-polarity rather than a reverse-polarity direct-current arc is preferred; and a helium-gas shield usually is employed instead of argon. With these conditions, welding is faster for a given current, and narrower weld beads are obtained.

Fig. 2. With a Straight-polarity Circuit, the Electrons Flow from the Tungsten Electrode to the Work. With a Reverse-polarity Circuit, the Electrons Flow from the Work to the Electrode. The Latter Circuit is Preferable where a Metal Develops an Oxide Layer



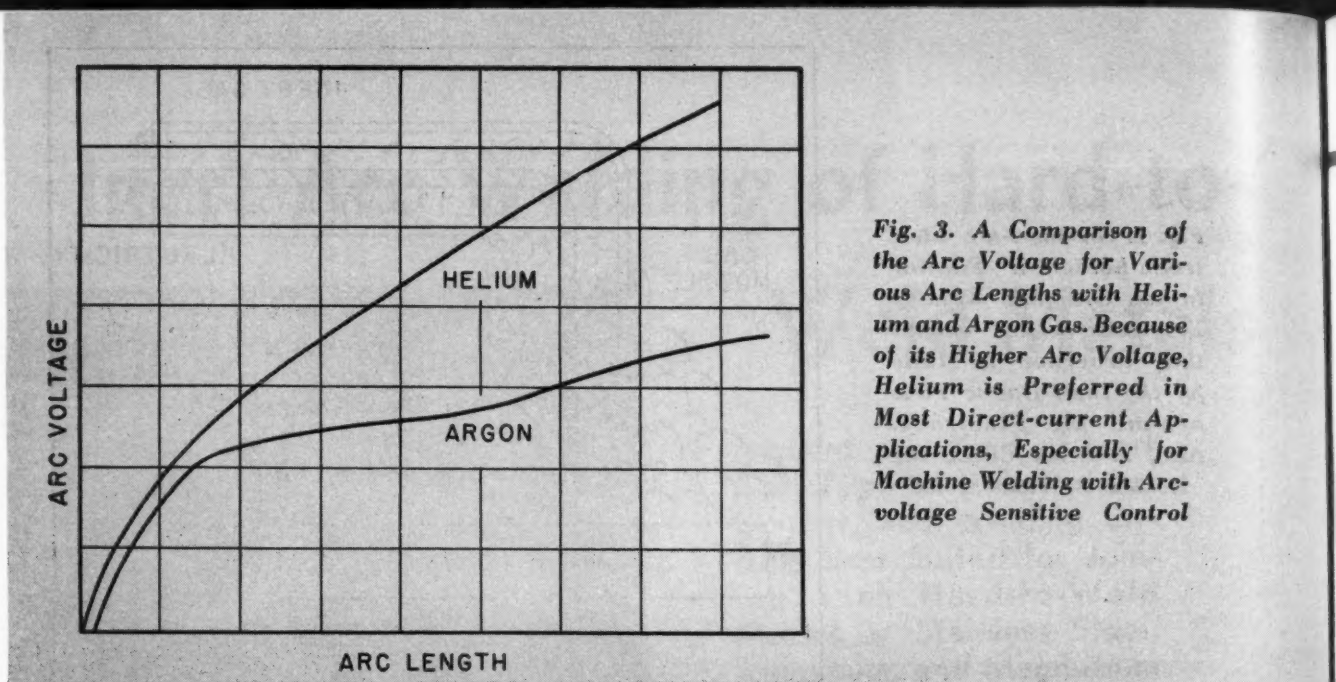


Fig. 3. A Comparison of the Arc Voltage for Various Arc Lengths with Helium and Argon Gas. Because of its Higher Arc Voltage, Helium is Preferred in Most Direct-current Applications, Especially for Machine Welding with Arc-voltage Sensitive Control

The narrower weld bead obtained with straight-polarity direct current means that there is a smaller heat-affected zone surrounding the weld. Thus, distortion is minimized. The reason for this narrower bead is that a smaller diameter electrode is used. The smaller electrode emits electrons in a small stream, which is directly applied to the work, resulting in a narrow weld bead and deep penetration of the base metal.

Alternating current is also frequently employed for inert-arc welding, and is recommended for metals such as aluminum that rapidly acquire a tough oxide layer or skin. The reason for this goes back to the previous discussion of the effects of polarity. Alternating current provides rapid fusion on the first alternation of each cycle (equivalent to straight-polarity direct current) ; and the oxide layer is dispersed in the second alternation of the cycle (equivalent to reverse-polarity direct current). When 60-cycle alternating current is used, this means that a change is made from rapid fusion to oxide layer dispersal sixty times a second.

To obtain current values of 10 to 30 amperes, a rheostat of 0 to 15 ohms must be used, since 30 amperes is the lowest current setting on a standard inert-arc welder. The rheostat is shunted with a 0.005-microfarad, 6000-volt capacitor to carry the arc striking pilot. Only in this manner is it practical to manually weld short butt joints in 0.013-inch aluminum.

Alternating current is also preferable for high-speed machine welding on thin sheets of any metal where current of 50 or more amperes can be employed. When direct current is used in applications of this kind, there is a tendency for the arc to lag behind the electrode momentarily and then snap forward. This irregular arc results in irregular weld penetration. Alternating current overcomes this difficulty.

Alternating-Current Circuits with Superimposed High-Frequency Components

One reason that alternating current was not applied commercially for inert-arc welding at an earlier date is that the oxide layer on the surface of some metals acts as a rectifier. The alternating-current supply is converted to half-cycle, pulsating, straight-polarity, direct current, and a poor quality weld having oxide inclusions is obtained. Continuously superimposed high-frequency current across the arc helps the 60-cycle current break through the oxide layer, but it introduces a serious possibility of only partially overcoming rectification, which means that there is direct current along with the alternating current in the circuit.

Although aluminum and similar metals can be welded satisfactorily with such a circuit, the direct-current component is troublesome. This introduces arc blow, which is inherent in direct-current welding; it saturates the welding transformer core, causing overheating and undesirable harmonic current in power lines; and finally, it requires a greater flow of shielding gas than sine-wave alternating current.

An early step in eliminating the direct-current component was to raise the open-circuit voltage of the welder to above 150 volts when argon gas was used. Another solution was to "buck out" the direct current by connecting

automobile storage batteries into the welding lead as follows: First, connecting the batteries in parallel, using one battery for each 100 amperes of welding current; and second, connecting the positive terminal of the battery bank to the electrode-holder and the negative terminal to the welder. This circuit eliminated most of the direct-current component and improved the weld bead quality. Although several such circuits are in use today for production welding, the amount of floor space and the maintenance required by storage batteries make them inconvenient to use. In addition, the 6-volt "bucking" current of the batteries may be more than required in one case, and less in another.

The most satisfactory circuit is one similar to that shown in Fig. 4. The most important components in this circuit are the series capacitors, which are connected in parallel to prevent the flow of any direct current. Thus sine-wave alternating current is obtained. The high-frequency pilot is used only when striking the arc, in order to prevent picking up aluminum on the tungsten electrode. The pilot, as well as the electrically operated inert gas and cooling water valves, is actuated semi-automatically by a foot switch or automatically by a control panel.

The hazard associated with open-circuit potential has been reduced to a negligible value by the control used with this system. When a foot switch or push-button is used, the electrode is dead until the start position is actuated, and this occurs only after the electrode is presented to the work to start the arc. Since the arc usually starts in a fraction of a second, the duration of the open-circuit voltage is brief.

More recent controls operate on the "idlematic" principle, using no foot- or hand-operated switch. The arc is started by a pilot circuit a fraction of a second after the tungsten electrode is lifted from the work. Power is automatically shut off as soon as the arc is broken, leaving only a low-control voltage on the electrode. Since only a control current of a few amperes flows while the electrode touches the work, there is no pick up of material on the electrode.

Up to the present time, it has been found preferable to use argon as the inert gas in production welding with alternating current. Several investigators are experimenting with the use of helium, as well as mixtures of various other inert gases.

Procedures for Welding Thin Sheets

When thin metal is being welded, deep penetration or excessive heat input will often result in burning through the sheet. With reverse-polarity direct current, the electron flow, and hence the heat, goes to the electrode. Thus, the depth of weld penetration is reduced and the danger of burning through is minimized. This reversal of current is not always desirable, however, despite the reduced penetration, because it requires a larger electrode to absorb the extra heat without melting, and also because a wider weld bead is obtained. The wider weld bead is a result of the flow of electrons from a comparatively large area of the work surface.

For some materials, notably stainless steel,

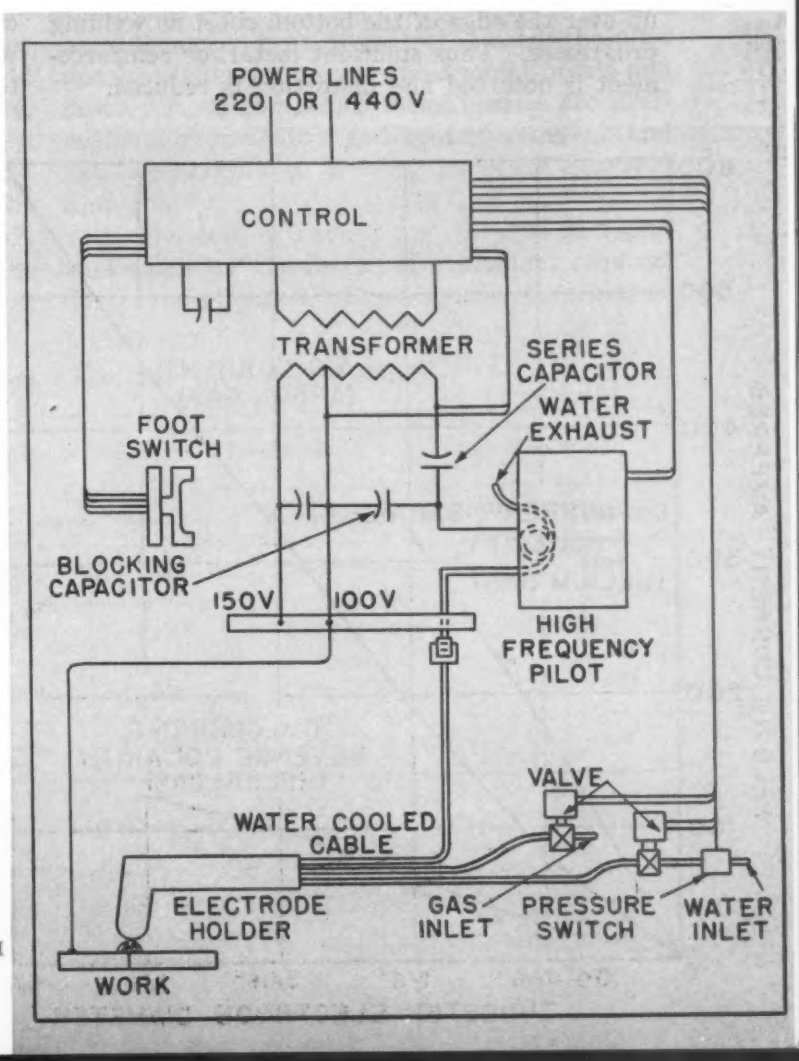


Fig. 4. Diagram of an Alternating-current Inert-arc Welder and Associated Equipment. The Series Capacitors Prevent the Flow of Any Direct-current Components

the emission area on the work is so large that it is almost impossible to hold a steady arc. In such cases, argon gas with a direct-current, straight-polarity circuit will give a cooler, more stable arc. This combination is particularly useful when welding thin stainless-steel sheets. The lower arc voltage in argon gas gives less welding watts, and therefore less heat, in the arc for a given value of welding current. This fact also introduces another advantage—a higher welding current can be used with argon. The welding arc attains maximum stability when the tungsten electrode is operated at maximum current density. The maximum practical current density for average conditions is shown in Fig. 5.

Even under the most favorable conditions, it is often quite difficult to weld a butt joint between two thin sheets without adding filler metal for reinforcement. One way of overcoming this trouble is to clamp the sheets so that they overlap a distance about double the sheet thickness at the weld starting point; at the point where the weld is to finish, the sheets should either just touch or barely overlap. When the proper welding procedure has been attained, no evidence of lapping will be found, except for the reinforcement. This occurs because the top sheet draws up over the edge of the bottom sheet as welding progresses. Thus sufficient metal for reinforcement is obtained and distortion is reduced.

Another method of providing the desired amount of reinforcement without adding filler metal is by using a flanged butt joint. The edges to be welded each have a right-angle flange which should be as small as can be produced in a bending brake. When these flanges are abutted, an edge joint effect will be obtained. The operator fuses this edge down as filler metal. Thus he obtains a butt joint with a reinforcement proportional to the height of the flanges. More distortion is likely to occur with this method than with the one previously described because there is some compression between the flanges when the weld is being made, but this is bothersome only on long joints.

An example of inert-arc welding of stainless steel is shown in Fig. 6 and in the heading illustration. The products—stainless-steel kitchen equipment—are fabricated from Types 302, 304, 316, 317, and 347 stainless-steel sheets ranging from 20 to 12 gage in thickness. Helium gas with a direct-current, straight-polarity arc and from 20 to 60 amperes of current are used. Welding speeds range from 6.5 to 18 inches per minute. These operations are carried out at the plant of S. Blickman, Inc., Weehawken, N. J.

The advantages of the inert-arc welding process are that no flux is needed, thus enabling weldments to be designed without considering the possibility of corrosion from entrapped flux; no post-weld cleaning or machining is required in most cases; the contour of the weld beads, especially when made by machine, is very regular; and some welds—particularly in aluminum and magnesium—remain bright as welded.

Best welding results can be obtained from the inert-arc process by taking into consideration the following factors:

1. For all-around, general-purpose inert-arc welding, alternating current with argon gas is preferred. This combination is extremely versatile, versatility being obtained with only a small sacrifice in speed when welding heavy sections. Alternating current

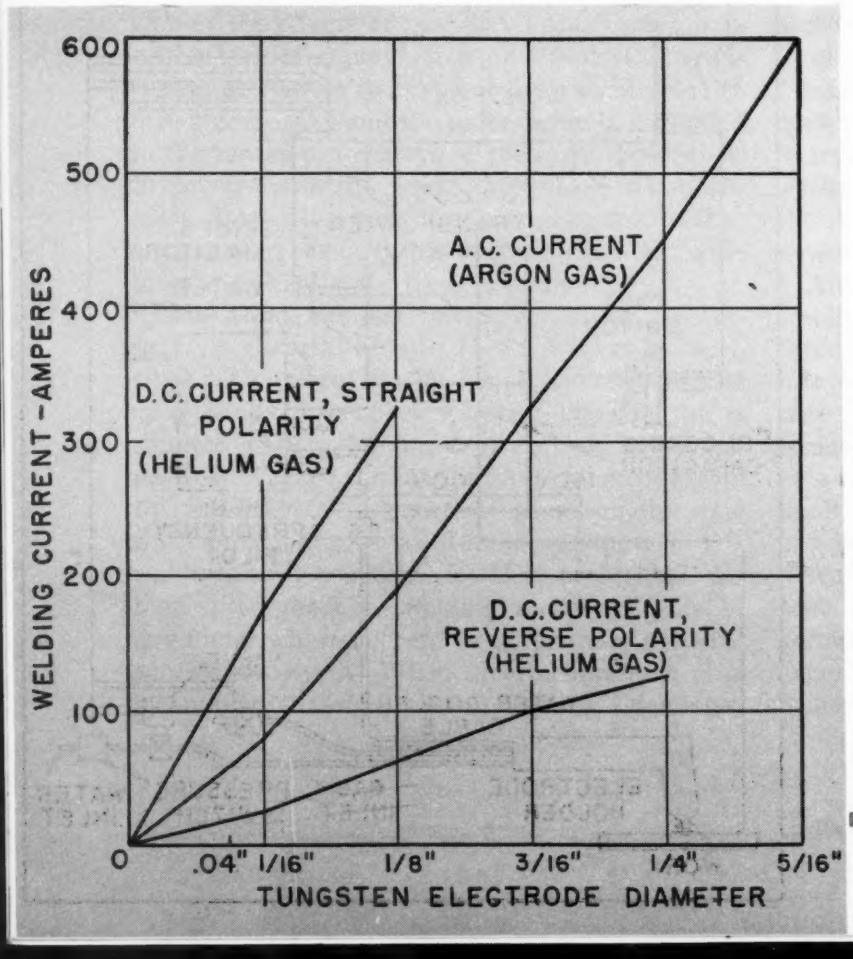


Fig. 5. Current Densities for Electrodes of Various Diameters. If Argon Gas is Used with Direct Current, the Current Values Increase About 25 Per Cent

Fig. 6. Welding Stainless-steel Kitchen Equipment. Welds are Made at the Rate of About 6.5 to 18 Inches per Minute, Using a Direct-current Straight-polarity Circuit and a Helium-gas Shield

should also be used when welding aluminum, beryllium copper, electrolytic copper, and magnesium, and seems preferable for yellow brass (33 per cent zinc). Direct current can be used for most other materials, except thin sheet that is to be machine welded at high speed with low current. The process selection chart, Table 1, can be used as a guide for inert-arc welding of hard-to-weld metals.

2. Argon welding gas should be used with alternating current and with direct current of less than 50 amperes; in other direct-current applications, one of which is shown in Fig. 7, helium gas gives the best results. This induction motor rotor is fabricated by welding copper rotor bars to form the motor end rings. The weld is made at the rate of 44 inches per minute, using 250 amperes of direct current and a straight-polarity circuit.

When helium gas is used, the flow should be maintained at from 20 to 40 cubic feet per hour; when argon gas is employed, the flow should be at the rate of from 10 to 20 cubic feet per hour. Higher gas flows are required with welding currents of 400 amperes or more. The use of a flowscope is more accurate for measuring gas flow than pressure gages, and is recommended for all applications of the inert-arc process.

3. Water-cooled electrode-holders should be used for welding currents above 100 amperes in all cases, and for currents above 60 amperes when the arc is being run more than four minutes out of each ten.

4. Ceramic gas nozzles should be used whenever high-frequency pilot spark circuits give trouble with metal nozzles; this may occur at 400 amperes or less of welding current. Unless an "idlematic" type of control is used, the pilot spark will jump to a grounded metal nozzle and destroy it. Water-cooled metal nozzles are preferable for durability and spatter removal, and are necessary with welding currents over 400 amperes.

5. The data in Table 2 may be used as a general guide for the rating of equipment required for any application. These figures are based on

Table 1. Process Selection Chart for Inert-Arc Welding

Material	Material Thickness	Direct Current, Straight Polarity		Direct Current, Reverse Polarity		Alternating Current	
		Helium Gas	Argon Gas	Helium Gas	Argon Gas	Helium Gas	Argon Gas
Light Metals (Aluminum, Magnesium, and Beryllium Alloys)	Thin Gage*	No	No	No	No	No	Best
	Heavy Gage	No	No	Fair†	Fair†	No	Best
Other Metals	Thin Gage	No	Good	No	No	No	Good‡
	Heavy Gage	Best	Good	No	No	No	Good

*0.030 inch and thinner. †For welding magnesium only.
‡For high-speed machine welding where current of 50 amperes or more can be used.

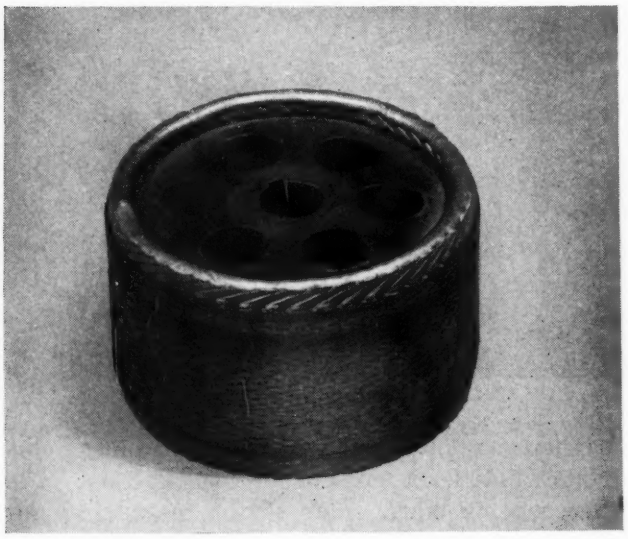


Fig. 7. Copper Bars are Welded together to Form the End Ring on an Induction Motor Rotor. The Welding Rate is 44 Inches per Minute

experience up to the present time, and should be used as guides rather than absolute rules. This data was obtained on welders rated on the basis of six minutes of arc time out of each ten minutes of operation (60 per cent duty cycle), except on the light-duty 150- and 200-ampere direct-current welders, which are rated on the basis of 40 per cent duty cycle and the 800-ampere alternating-current welder, which can be used continuously at 800 amperes. All of these machines can be used for a greater proportion of time when using less than the rated current. Manual welding rates rarely exceed even the lower time rating.

However, it may be found that these duty cycles are exceeded in machine welding. A reasonably correct formula that can be used to determine the permissible duty cycle is:

$$\text{Permissible Duty Cycle} = \text{Rated Duty Cycle} \times \frac{(\text{Rated Amperes})^2}{(\text{Amperes Used})^2}$$

For example, the nameplate of a welder might state that it has a 200-ampere rating at 60 per cent duty cycle (National Electrical Manufacturers' Association rating). This welder is to be used at 175 amperes of welding current for machine welding. How long can the arc be run out of each ten-minute period (the standard base of the duty cycle rating) without overheating the welder?

$$\text{Permissible Duty} = 0.60 \times \frac{200^2}{175^2} = 0.6 \times \frac{40{,}000}{30{,}625} = 0.6 \times 1.3 = 0.78, \text{ or } 78 \text{ per cent}$$

Seventy-eight per cent of ten minutes is, roughly, eight minutes of permissible arc time out of each ten-minute period. If the handling time is two minutes or more for each ten-minute cycle, the welder is satisfactory. If the proportion of handling time is less, or if the arc must run more than eight minutes at a time, a welder with a higher rating is required. (NEMA rated welders having a 40-volt load rating have a 60 per cent duty cycle.)

6. The tungsten electrode diameter and the welding current should approach the values obtained from Fig. 5. An unstable arc will result if the welding currents are less than 60 per cent of the indicated values, and tungsten consumption will be excessive with current values much in excess of those shown. With the proper inert-arc procedure, the tungsten electrode is semi-permanent. To prevent excessive oxidation of the electrode, the inert gas should be allowed to flow after welding until the tungsten reaches a black heat; this usually takes about ten seconds.

7. In order to avoid causing radio interference, a high-frequency pilot-spark circuit should be used only when starting the arc, if at all. With an inherently stable welder, the high-frequency circuit can be disconnected and the arc struck on a carbon block placed on or adjacent to the work. The arc can be struck directly on metals other than aluminum, but striking it on a carbon block insures that the electrode will not be fouled by the base.

Table 2. Welding Equipment Required for Various Thicknesses of Metal

Thickness of Metal, Inches	Welding Machine		
	Type	Rating, Amperes	Range, Amperes
0.030 to 1/8 1/16 to 1/4 3/32 up	Alternating-current	200 400 800	30–200 60–400 125–800
0.015 to 5/32 0.020 to 3/16 0.050 to 1/4 1/16 to 1/2 1/8 up	Direct-current (Motor-Generator)	150 200 300 400 600	30–185 30–250 60–375 80–500 120–750

Words of Wisdom from an Idol of Labor

ONCE upon a time a great jurist sat upon the bench of the highest court in our land and consistently cast his vote in favor of the downtrodden and oppressed. He came to be respected by great and small alike, but he became especially an idol of labor leaders and of the liberal minds of his day.

Strange that the wisdom of this great thinker should be completely ignored by some of today's labor leaders—that their policies have gone so far afield from his ideas. For example, in one of the most important speeches of his career he said:

"Employes should strive to make the earnings of any business as large as possible. There can be no greater mistake for the workingman than to restrict the output of the individual. You must make the total earnings of the business . . . the largest possible. . . . I mean the aggregate fund available for paying workingmen, capitalists, and managers. Make this aggregate large and there will be plenty for all among whom it is to be divided. . . .

"Any restriction upon the output of the individual reduces the fund of profits available for distribution, besides demoralizing the man who is so restricted.

"It follows also that differences in efficiency between different individuals must be recognized and rewarded; and that those who can work faster and better than the others must not be retarded by the less efficient. . . .

"A limitation of the production of the individual is pure waste. The business is merely rendered less profitable. . . . Nor does the restriction of the output make more work for others. . . ."

Who was this eminent man? The late Associate Justice of the United States Supreme Court, Louis D. Brandeis.

The proof of these precepts was never more obvious than today. And yet we see labor leaders berate business for earning profits, whereas Brandeis said that the earnings should be the largest possible. Limitation of production is an aim of too many labor union officials, while the learned jurist pointed out that restriction of output did not result in creating work for more people. The other important point—that efficiency of the individual should be rewarded—is practically an impossible objective in shops that are union-controlled.

Now that the 1948 presidential election is over and, we hope, irrational oratory is at an end for a time, it behooves all of us to get back to some honest thinking on economic facts as they control industry and the welfare of the workingman—honest thinking along the lines espoused by Justice Brandeis.

Charles O. Herb

EDITOR

Grinding Fine-Pitch Gears

Paper Presented at a Symposium on Gear Tooth Grinding before the Recent Semi-Annual Meeting of the American Gear Manufacturers Association

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THE process of grinding gear teeth is usually employed as a finishing operation. In the case of fine-pitch gears, however, it also serves, for the greater portion of the fine-pitch range, as a combined cutting and finishing operation.

There are two principal methods of grinding gear teeth, which may be distinguished as form-grinding and grinding by generation. Grinding is used as a finishing operation on heat-treated, hard gearing and master gears, as well as in cases where a high degree of surface smoothness is required. In some instances, grinding by generation is actually an economy over other methods of cutting gear teeth. In all cases, it is the experience of this company that grinding is practical on a wide variety of materials, such as tool steel, mild steel, stainless steel, iron, aluminum, bronze, brass, Micarta, and other compounded materials. Grinding of coarse-pitch gears is frequently confined to the tooth sides, while with fine-pitch gears, the grinding wheel usually cuts not only the sides, but also the root.

The two methods—form-grinding and generation by grinding—have certain distinguishing limitations and characteristics. The process of form-grinding employs a wheel that is shaped according to the contour of the tooth space. Truing, or dressing, of the wheel is usually performed by diamonds, but crushing can also be employed. Diamond dressing is popular because it is fast, cheap, flexible, and contributes to a high degree of accuracy. Flexibility, with respect to special pitches and pressure angles, and even modified profiles, is an important advantage of this method.

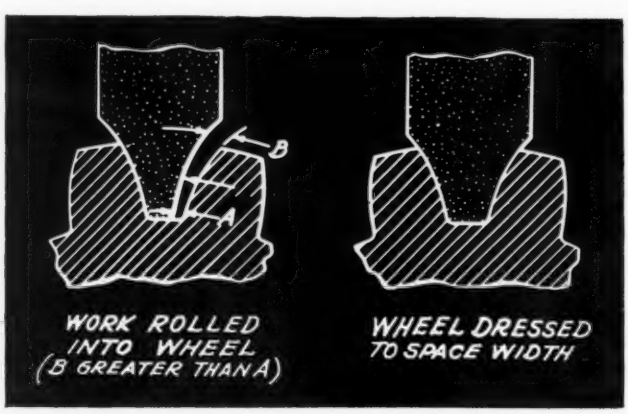


Fig. 1. Two Methods of Form-grinding Gear Teeth. At the Left, the Grinding Wheel is Thinner than the Space between the Teeth and Grinds Only One Side of One Tooth at a Time

The accuracy of the form on the wheel is a prime consideration; however, it must be stated that associated problems are far less critical in the case of fine pitches than coarse pitches. Although the involute profile is a line with continuously changing curvature, it is possible, in many cases, to substitute a simple arc in place of the involute form. Since the deviations of this arc from the theoretical profile are proportional to the pitch, it is obvious that deviations which may be serious in the case of coarse pitches will be less significant in the finer pitches.

Form-grinding is particularly suitable when the number of teeth is high. Low numbers of teeth may require some under-cut, which the form-grinding process does not provide without resorting to impractical procedures. However, the thickness of material removed by under-cutting, measured from the theoretical involute form, is relatively insignificant unless the required under-cut is too radical. It is possible to tolerate a slight degree of involute interference as long as this interference is less than the minimum backlash.

The process of form-grinding is sometimes associated with the misconception that liberal tooth-thickness tolerances cannot be allowed, because down feeding of the wheel results in improper profile deviations. This problem is met by keeping the position of the grinding wheel undisturbed once a satisfactory tooth profile has been established. Changes in tooth thickness of the work-piece are then effected by a circumferential adjustment of the indexing assembly.

With this method, the grinding wheel is thinner than the space to be cut and contacts one side only. The work is finished by first indexing completely around and then repeating the process after the unfinished side has been rolled against the wheel by circumferential index readjustment, as seen at the left in Fig. 1. This assures high accuracy of profile and of tooth thickness and is recommended where high precision is demanded. However, it requires numercus light cuts, and is therefore time-consuming.

Another method can be used when the volume of production, in combination with the number of teeth, does not justify the multiplication of indexing operations, and also when the type of cut and the size of the pitch radius precludes the application of one-sided grinding pressure. With the second method, the wheel is dressed to the thickness of the space, as shown at the right in Fig. 1, and grinds both sides simultaneously. The tooth thickness is predetermined by the dresser, which is mounted on the machine table in fixed relation to the work axis.

With helical gears, difficulties may be incurred because the profile on the wheel is not identical to either the transverse or normal section. The same problems exist as in the case of thread grinding because of the peculiar geometrical relationship between the wheel profile and that of the work. However, it is possible to predetermine the wheel profile on the basis of an exact mathematical method which strictly conforms to the characteristics of generation along a helical path.

Although there is no great difficulty in providing the involute profile on spur gears, problems arise at the root when the pitch is extremely fine. These problems are connected with grinding wheel breakdown at the tip when the width of the tip is extremely narrow. The experience of this company shows that the tip width of the wheel, which corresponds to the space width at the root diameter of the finished gear, should not be less than 0.005 inch. If some thought is given to the grain size of the grinding wheel (approximately 0.0025 inch for wheels of 220 grit), it will be appreciated that a space width of 0.005 inch represents an extremely successful performance of the wheel.

This condition appears to limit the range of fine-pitch work that can be finished by this method to about 120 pitch for a 20-degree pressure angle, and 180 pitch for a 14 1/2-degree pressure angle. It should be recognized that grinding of very fine-pitch gears requires careful selection of the grinding wheels, thoughtful application of the coolant, and extreme care in the wheel dressing operation.

Gear-Tooth Tolerances Maintained in Form-Grinding

Gear-tooth tolerances that can be maintained by form-grinding are given in the accompanying table for standard precision master gears. The table shows a total variation of the involute profile of 0.0002 inch, half of which is provided for measuring errors of the checking equipment. Greater run-out accuracy than the values shown in the table can be obtained through selection.

Tooth-thickness tolerances can be readily liberalized or reduced as the case requires. Tolerances for ground fine-pitch work-gears range from the values given in the table up to the limits with which the gears are acceptable. The

Vinco Standard Tolerances for External Master Spur Gears

Gear Element	Tolerances, Inch*	
Tooth Thickness		
Up to and including 4 inches pitch diameter	± 0.0001	
4 inches up to and including 8 inches pitch diameter	± 0.0002	
Involute Profile	± 0.0001	
Parallelism of Teeth with Axis		
Up to and including 2 1/2 inches face width	0.0002	
Over 2 1/2 inches face width	0.0003	
Spacing of Any Three Consecutive Teeth		
Up to and including 4 inches pitch diameter	0.0002	
4 inches up to and including 8 inches pitch diameter	0.0003	
Run-out, Measured Over Standard Gear Wires, Total Indicator Reading	14½ Deg. Pressure Angle	20 Deg. Pressure Angle
Up to and including 4 inches pitch diameter	0.0004	0.0003
4 inches up to and including 8 inches pitch diameter	0.0005	0.0004
Bore Diameter		
Up to and including 1.500 inches diameter	+ 0.0002	
1.500 inches up to and including 4.500 inches diameter	+ 0.0003	
Outside Diameter		
Up to and including 4 inches pitch diameter	+ 0.001	
4 inches up to and including 8 inches pitch diameter	+ 0.002	
Locating Face Run-Out—Total Indicator Reading	0.0001 per inch of diameter (0.0001 min.)	

*These tolerances suit the majority of requirements, but may be modified when necessary.

spacing, which is determined by the index-plate; the profile which depends on the set-up; and the parallelism, which is controlled by mounting conditions, need not be appreciably altered from this tabulation, even if production runs are contemplated. Greater tooth thickness and run-out tolerances allow for variations in the fit on the arbor, grinding wheel wear, etc.

Generating Method of Grinding Gears

The second principal method of grinding gear teeth is based on the process of generation with a straight-sided, rack-shaped tool. The generating motion is accomplished by two different arrangements. The first arrangement is embodied in the Pratt & Whitney or Maag gear grinders, which generate one tooth in one cycle and require indexing, as in the case of form-grinding. Since each reciprocation of the wheel finishes only a very short element of the tooth profile, this method is usually slower than form-grinding. Its main advantages lie in the ease of controlling the profile of the grinding wheel, and its adaptability to the generation of gears that require a definite under-cut, as well as helical gears. Since profile control and under-cut are not critical in the case of fine-pitch gears, most of which are spur gears, this type of generation is not widely used for fine-pitch gears.

The second arrangement of generation by grinding is based on the principle of hobbing a threaded grinding wheel being employed in the same manner as a hob. It has the advantage of eliminating the indexing cycles, and is equally suitable for gears with and without under-cut and for spur, helical, and spiral gears. The conception of this process is by no means new, the idea of using a threaded wheel dating back to 1890.

In this continuous generating arrangement, a timed relation is maintained between the rate of revolutions of the grinding wheel and the work-piece. The threaded grinding wheel has an axial section equal to the basic rack of the gear-tooth system. The linear pitch of the tooth spiral on the grinding wheel is equal to the circular pitch of the gear to be cut. The truing and dressing operation on the grinding wheel constitutes the most critical phase of this undertaking, and much thought and ingenuity have been invested in this phase of operations.

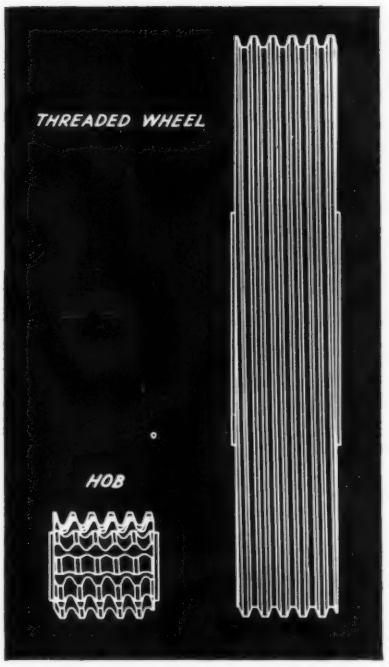


Fig. 2. Threaded Grinding Wheel, Seen at the Right, Cuts Gear Teeth in the Same Manner as a Hob

In this company's original studies of this arrangement, the fact was recognized that contact between the wheel and the work would be a spot contact, which travels along a spiral on the threaded wheel, if this process is used for finish-grinding, and that the perimeter of the wheel would be subjected to the greatest wear if it is used for gear-cutting. In order to distribute the contact with the work-piece over the whole working area of the wheel, provision was made for either manual or mechanical axial adjustment of the wheel position, a feature that is analogous to the shifting of hobs. When this wheel adjustment is performed by a continuous mechanical motion, it is necessary, of course, to provide for a corresponding acceleration or deceleration of the work-piece.

Preventing Wheel-Tip Breakdown

The risk of wheel-tip breakdown, which has a fundamental relation to the economy of the process as a whole, was minimized by the use of a grinding wheel of about 18 inches diameter. The large grinding wheel diameter has the desirable effect of reducing the helix angle on the grinding wheel, which, for 20 diametral pitch, would be only about 10 minutes. Errors caused by deviations of the grinding-wheel surface from a true involute helicoid are therefore negligible.

Notwithstanding the large diameter of the wheel, some measure of tip breakdown is to be expected. This was found to cause a rounding of the leading edge of the wheel-profile crest rather than a rapid outside diameter reduction. This peculiar tip breakdown leads to a lack of symmetry in the root shape of the work-piece which, if objectionable, can be controlled by reversing the direction of machine rotation.

A limitation of the use of the threaded wheel for generating gear teeth was found in connection with the diametral pitch. Up to this time,

we have not been able to provide wheels for pitches finer than 64 because of space restrictions at the root of the wheel, which, for finer pitches, becomes inaccessible. A difficult problem is encountered even in the case of 64 pitch, if it is associated with a 20-degree pressure angle. Fewer difficulties, of course, are experienced when the pressure angle is 14 1/2 degrees.

It should be possible to meet this problem by increasing the lead of the wheel so that it corresponds to a multiple of the circular pitch to be ground; in other words, by straddling two teeth in the work. This expedient can be resorted to, provided the number of teeth on the work is not a multiple of the number of pitches between wheel crests. The width of the crest would then present a secondary limitation with respect to very fine pitches.

There is, in principle, no limit with respect to the coarseness of the pitch, but it was found that this process, just as well as any other process of gear-cutting or gear generation, is more successful and requires relatively less effort when pitches are fine.

Our experience with this method of grinding covers a great variety of gears and gear materials. Fine-pitch gears down to about 20 pitch and perhaps finer are usually cut from the solid blank without additional finishing operations.

In the case of coarse-pitch gears, the process has been used for roughing and finishing purposes, and also as a salvage operation on heat-treated parts which were defective with regard to profile, spacing, or run-out. Adequate improvement of such defective parts was possible by free wheeling, without the use of the timing mechanism, in order to eliminate the problem of picking up existing tooth spaces.

Tolerances maintained by the use of this method are relatively close. They range from 0.0001 to 0.0002 inch on spacing; 0.0002 to 0.0003 inch on profile; and 0.0003 to 0.0005 inch on run-out. Statistical performance records are not yet extensive enough to establish definite tolerance charts and production time ratings.

It may be stated, however, that on the average, the use of this process has resulted in grinding time reductions up to about 80 per cent. Including set-up and dressing time, a cost reduction of about 30 to 50 per cent has been realized. In the case of fine pitches, especially where light metals or soft materials are cut, production time is comparable, although not superior, to that of hobbing. Generation grinding with a threaded wheel should be expected, therefore, to maintain its place, not only where hardened steel is involved, but also where better accuracy and finish may be desired without excessive additional cost.

Carpenter Steel Co. Completes New Research Laboratory

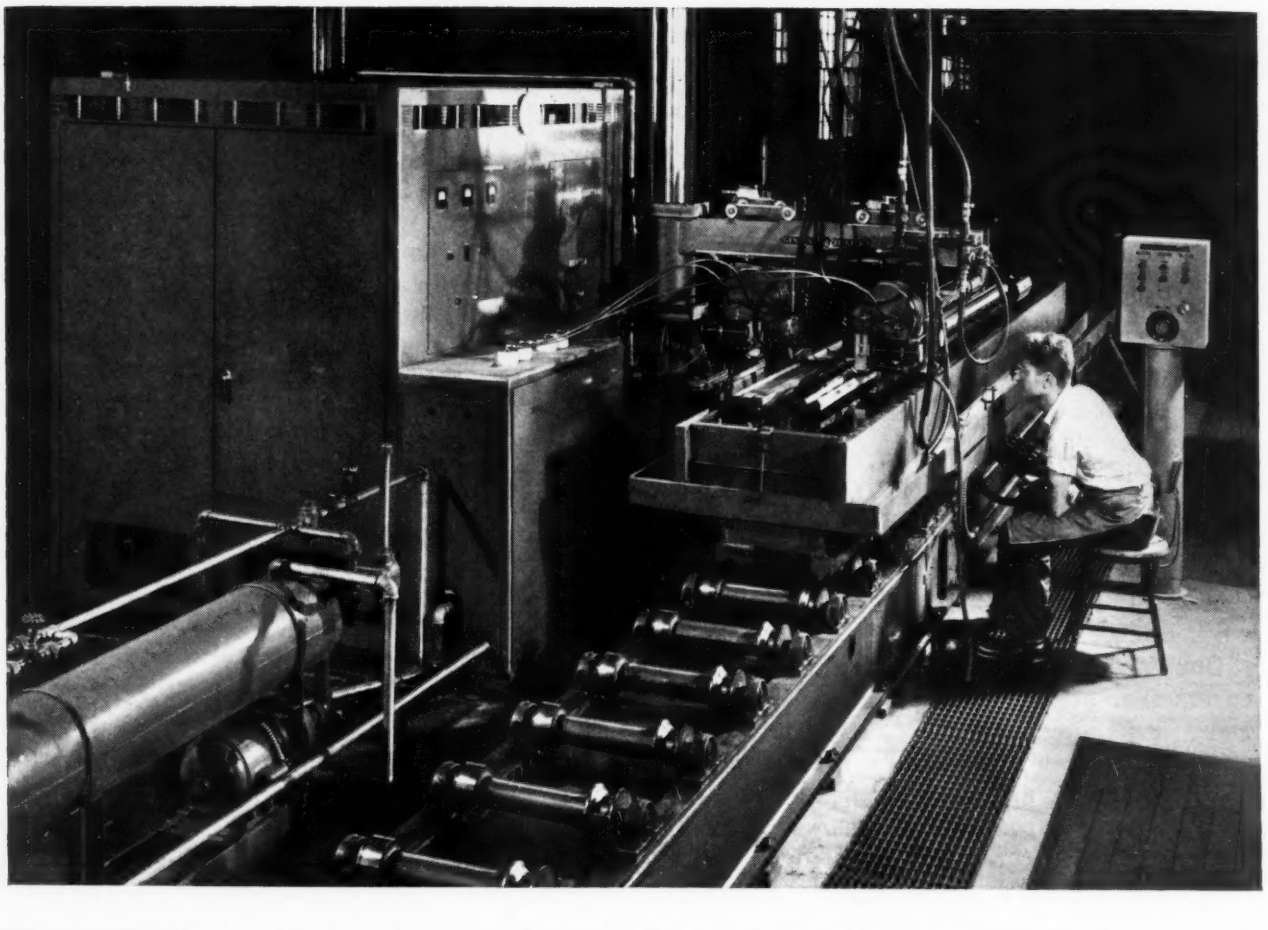
The Carpenter Steel Co., Reading, Pa., recently completed a new research laboratory for the use of the metallurgical department, and dedicated it to the Carpenter personnel who served in the Armed Forces of World War II. The laboratory, consisting of a three-story building with a total area of about 9000 square feet on each floor, comprises a physical testing laboratory, together with a machine shop and a storage area; a general metallurgical laboratory, including a library, experimental heat-treating room, microscopes, etc.; and a chemical laboratory.

The activities of the laboratory are three-fold —to provide mill service, such as the servicing of all pyrometers throughout the plant, chemical analyses, physical and microscopic tests, and routine optical temperature service on the mills and hammers; to render customer service; and to carry on research work on new products, improved processes of manufacture, and new uses.

* * *

For Fast Sorting of Metal Parts with Respect to Hardness and Differences in Materials, the Property of Magnetic Permeability is Useful. In the Illustration is Shown a Magnetic Comparator Developed by the Hunter Spring Co., Lansdale, Pa., which Records on an Oscilloscope Any Defects in Parts Placed in the Electrical Field

High-Frequency Induction Hardening



INDUCTION heating has been widely used for the localized hardening of gears, racks, cams, shafts, and other parts. Now the Hendey Machine Co., Torrington, Conn., is applying this process for hardening the ways of precision and production lathe beds ranging in length from 6 to 16 feet. Case hardness depths of 0.093 to 0.125 inch are attained, with a Scleroscope hardness reading of 70, which is approximately equal to 500 Brinell.

This method of hardening has been found to be particularly suitable for long parts, such as these lathe bed ways, that must be held to a high degree of straightness because the hardening cycle is so rapid that little distortion occurs. The maximum distortion of the lathe bed ways is 0.012 inch in a length of 6 feet.

Basically, induction hardening is accomplished by electrically generating heat within a metallic part to raise the temperature of the part to a predetermined point, at which it is quenched. The work is placed in close proximity to a heating coil, or inductor, which carries a high-frequency alternating current. This current induces an electromagnetic field which is intercepted by the work. Thus heat is generated within the work because of its resistance to the flow of eddy currents set up by the magnetic field.

The Hendey lathe bed castings, which have a combined carbon content of 0.70 per cent, are aged and then rough-planed, after which they are allowed to stand for a period of time to remove machining strains. This is followed by a finish-planing operation which leaves 0.020 to 0.025 inch of stock to be removed by grinding. After holes have been drilled in the beds for mounting on bases, the beds are hardened.

A 50-KW General Electric electronic heater, shown in the heading illustration, is used for the hardening operation. The beds are placed against a straight locating surface on a special table. Proper alignment insures a uniform spacing between the coils and the work while the lathe bed ways are passed between the coils. In addition to this, the machine is provided with special heating coil heads which are free to move in a direction at right angles to the table travel. These heads are actuated by rollers located in front and in back of each coil, as shown in Figs.

# of Lathe Bed Ways

By GEORGE H. DeGROAT

An Application of Induction Heating that Demonstrates the Value of This Process for Hardening Long Parts with a Minimum of Distortion

1, 2, and 3. As the table carries the work between the heating coils, the guide rollers revolve in contact with the lathe bed ways. Through their connection with the floating coil heads, the guide rollers move the coils into alignment with the ways.

An interesting feature of the table drive is an electronic control system which operates on the alternating-current power supply of the shop and consists, principally, of a transformer and a thyratron tube panel. Stepless control of a direct-current motor which drives a pinion engaging a rack on the table is provided by this system. Termed a "Thy-mo-trol" by the General Electric Co., this unit is operated at a central control panel and provides a rate of travel for the table ranging from 0 to 30 inches per minute. Generally, the "Thy-mo-trol" is set to drive the table, which rides on rollers, at the rate of 2 to 5 inches per minute, depending upon the section being heated. At this rate, the work is exposed to heat for the proper length of time to obtain the desired hardness characteristics, and the ways of two lathe beds—over 6 feet long—which are mounted on the table in tandem, are hardened in approximately 1 1/4 hours.

Of vital importance to the induction hardening process is the quenching operation. Special quench heads have been developed to direct the quench spray to the exact location on the work where heat is applied. These heads are designed to utilize an air stream, by means of which the operator can control the direction and location of the water to obtain a sharp dividing line between the hot section of the ways and the cool (or previously quenched) section. Heating coil design is also an important consideration of the process. The coils used in hardening the lathe bed ways have been designed to permit uniform depth of heat penetration without overheating small cross-sectional areas. One of these coils may be seen in Fig. 3.

Upon completion of the hardening operation, the lathe beds are removed from the table of the machine by means of an overhead bridge crane, and are placed in cradles, where they are tested for hardness, as shown in Fig. 4. The bases of the lathe beds are finish-planed after hardening and then the legs and pan are mounted in place. By grinding the ways after the beds have been assembled to the bases, any deformation that might be caused by tightening bolts in assem-

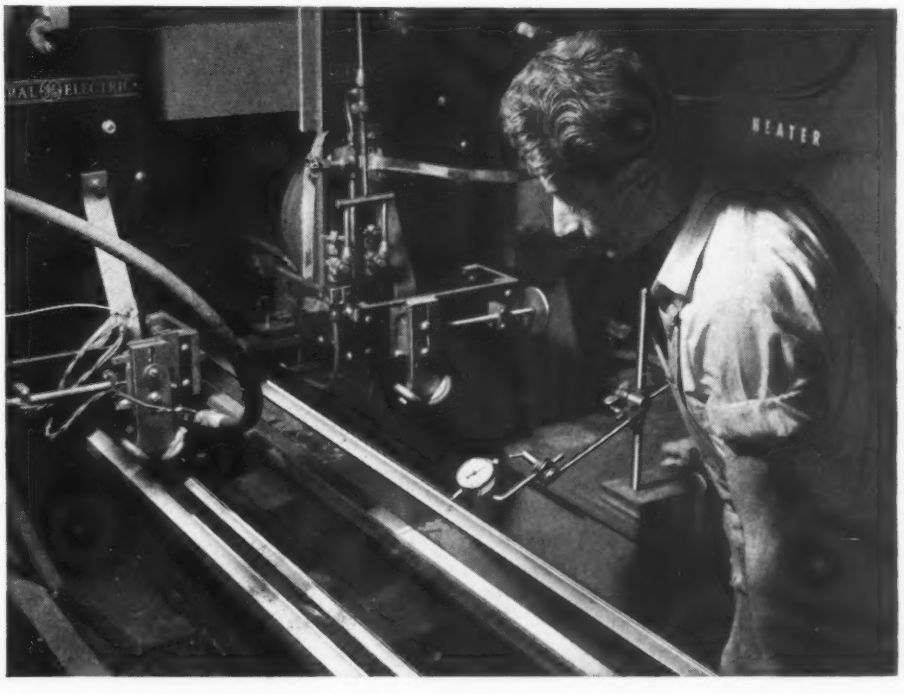


Fig. 1. Locating Lathe Beds on the Induction Heating Machine Table for Alignment with the Heating Coils

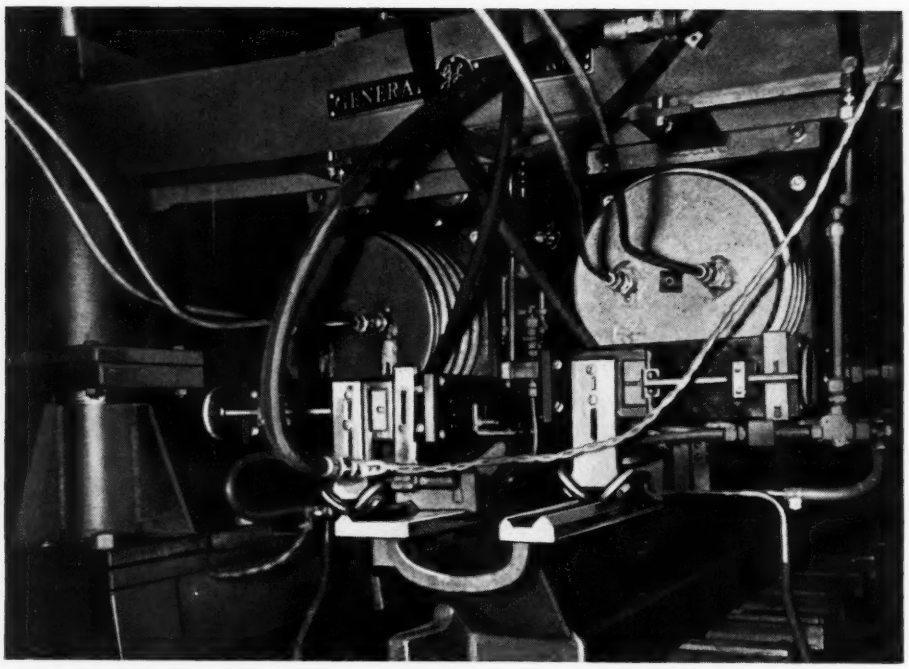


Fig. 2. The Electronic Heater is Provided with Special Heating Coil Heads which Float to Maintain Uniform Spacing with the Work

bling is removed. A large Thompson hydraulic surface grinder having a 20-foot table travel is used for grinding the ways, as shown in Fig. 5. This machine has been equipped with a special vertical head for grinding the sides and under surfaces of the ways.

In this operation, straightness of the lathe bed ways is held to extremely close tolerances. Following grinding, the lathe beds are carefully inspected for straightness by means of special fixtures, after which a final hardness test is made. Lathe carriages are scraped to fit the beds after the grinding and inspection operations.

Processing of the lathe beds after hardening is considerably facilitated by induction heating, due to the small amount of distortion produced, the lack of hardening scale, and the uniformity of hardness. Distortion is minimized because of the rapid localized heating and quenching cycle, which does not give temperature changes sufficient time to produce deformation. For the same reason, oxidation cannot take place and scale is not produced. Resistance of the material to the flow of eddy currents is one of the principal factors affecting the heating rate in induction hardening. Control over the heating rate is maintained by increasing or decreasing the intensity of the magnetic field. The strength of

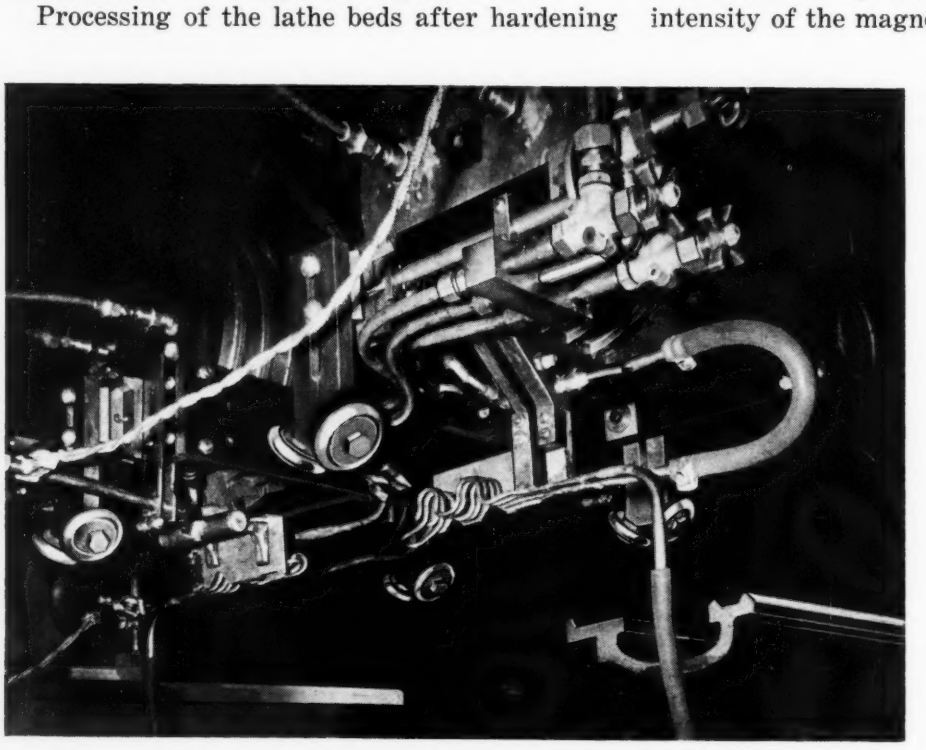


Fig. 3. Coil Design is Important in Induction Heating. These Coils were Developed to Avoid Overheating Small Cross-sectional Areas in the Lathe Bed Ways

the field varies inversely as the square of the distance of the coil from the surface of the work, so that spacing between the heating coil and the work is made small for fast heating and is increased for slower heating.

Depth of heat penetration is primarily dependent upon the current frequency and the power output of the generating equipment. The higher the frequency of the heating coil current, the greater is its tendency to follow the contour of the part that is in proximity to the coil. Inasmuch as the induced electromagnetic field follows the direction of the high-frequency current flow, control over surface contour heating is provided, but the initial depth of heat penetration is small. Shallow heat penetration, such as may be required for hardening thin strips, is obtained by frequencies of about 1,000,000 cycles per second or greater. Deep penetration is provided by frequencies of 1000 to 10,000 cycles per second. Surface heating is generally accomplished by currents with frequencies ranging from 200,000 to 500,000 cycles per second. Heat may be conducted from the initial depth of penetration to greater depths if the heating time is long enough and if sufficient generator power is available.

The General Electric induction heating equipment used for the application described generates 275-ampere current in the heating coils at a frequency of 530,000 cycles per second. This equipment operates on a 440-volt, three-phase, 60-cycle power supply line, and contains an air-cooled transformer which steps up the power supply voltage. The stepped-up voltage is supplied to six rectifier tubes. A water-cooled oscillator and capacitors are furnished with water at the rate of fifteen gallons per minute by a pump and tank unit, seen in the left foreground of the heading illustration. This unit also supplies a flow of water at the rate of 3/4 gallon per minute for cooling the heating coils. Automatic controls which regulate the entire hardening operation are located at a central panel.

* * *

Sinclair Research Center

The Sinclair Refining Co. has built the Sinclair Research Center at Harvey, Ill., which covers 38 acres and consists of nine buildings having a total floor area of over 200,000 square feet. The objectives of the new research and development laboratories are to contribute to the improvement of petroleum products, to find new products, and, in general, to enhance the service rendered to the public by the petroleum industry.

Fig. 4. A Scleroscope Hardness Reading of 70 is Obtained on Hardened and Ground Lathe Bed Ways

Fig. 5. A Thompson Hydraulic Surface Grinder with a 20-foot Table Travel is Used for Grinding Lathe Bed Ways. This Machine is Equipped with a Special Vertical Head for Grinding the Sides and Under Surfaces of the Ways

Engineering News

Mobile Betatron Produces X-Rays that Penetrate 16-Inch Steel

The world's first mobile betatron—a 10,000,000-volt General Electric X-ray generator whose rays are capable of penetrating 16 inches of steel—is being installed at the Naval Ordnance Laboratory, White Oak, Md. This massive betatron can be aimed in any direction. It will be used principally for studying the complex internal assemblies of mines, torpedoes, and other Naval ordnance items.

The betatron consists essentially of a powerful electromagnet weighing approximately 2 1/2 tons, which surrounds a doughnut-shaped glass vacuum tube in which electrons are accelerated and made to produce X-rays by striking a tungsten "target." Engineers who built the betatron state that it can take an X-ray picture of a piece of steel 1 inch thick in one second. Its rays can penetrate a piece of steel 1 foot thick in a matter of minutes, as compared with hours for a conventional X-ray machine.

High-Temperature Ceramic Coatings Protect Metals from Oxidation

The lack of materials with the required properties for operating temperatures in excess of 1800 degrees F. has been a restrictive influence in the development of jet engines and rockets. Scientific investigations at the National Bureau of Standards have been directed toward the development of ceramic coatings for metals having very high melting points, in order to protect them against oxidation at high operating temperatures. Preliminary results indicate that molybdenum with a specially designed ceramic coating offers a promising combination for very high-temperature service.

The ceramic coatings developed to provide this protection to molybdenum are applied in the form of water suspensions or "slips" to cleaned specimens of molybdenum by either dipping or spraying. After drying, the pieces are fired at a temperature of 2150 degrees F. in a furnace having an oxygen-free atmosphere. The furnace is the only special equipment needed beyond that normally used in applying ceramic coatings.

At a gas temperature approximating 3500 degrees F., giving a surface temperature on the specimen of 2600 degrees F. or more, only short-time protection of the molybdenum was attained. The oxidation rate at these high temperatures was found, however, to be sufficiently retarded by the presence of the ceramic coating to make the use of coated molybdenum feasible for special high-temperature applications in which prolonged service is not required.

Rapid Analysis of High-Temperature Alloys during Manufacture

A new process control employed in the manufacture of a high-temperature alloy for turbine-driven engines has been reported by General Motors Research Laboratories. This control method employs the emission spectrograph, and was developed primarily for analyzing the cobalt-base alloy known commercially as "Vitallium." The method has progressed to the point where analyses can be completed in a matter of minutes, during the production process, thus saving a great deal of time compared with the time-consuming chemical analyses previously required.

Samples of the alloy are analyzed from a photographic record of a line spectrum taken from an arc flame burning on an electrode. The Vitallium sample to be analyzed forms one of the electrodes and carbon is used in the other. From the density of the spectrum lines on the photographic film, physicists can determine the percentages or quantity of the various elements in the alloy and make immediate corrections in the molten metal.

Compound Engine Increases Range of Navy Planes 20 Per Cent

The range and power of America's military and commercial planes of the future will be increased 20 per cent as a result of the development of a new type of aircraft engine which will be put into quantity production by the Wright Aeronautical Corporation, Wood-Ridge, N. J. This engine, called the Wright turbo-cyclone 18 compound engine, is to be built for the U. S.

Navy. It combines a reciprocating engine with three velocity turbines which operate on exhaust gases to recover approximately 20 per cent of the available heat energy normally lost in exhaust. Conversion of these gases into power, which is geared back directly to the crankshaft, adds 20 per cent to the horsepower developed by the engine for the same fuel consumption.

(Right) Boring Two 8-inch Holes in Each of Two Main Gantry Supports for 40-yard Strip Mining Power Shovel at Steel-Weld Division of the R. C. Mahon Co., Detroit, Mich.

(Below) Side View of Gantry Supports, which are About 58 Feet Long and Weigh 16 Tons Each. The Gigantic Shovel for which These Gantries have been Constructed will Remove Material at the Rate of 50 to 60 Tons in Each Bite

Cutting Sprockets for Silent Chain

By J. L. JESSUP, Master Mechanic
Colonial Broach Co., Detroit, Mich.

BECAUSE of slow delivery from a manufacturer or supplier, it frequently becomes necessary to make a part for a machine or mechanism in the shop. Such was the case with a set of sprockets for a silent chain drive, which were available only on the basis of a four-week delivery date. It was, therefore, decided to make milling cutters for milling the teeth in the sprocket blanks.

By referring to MACHINERY'S HANDBOOK, it was found that the angle formed by the inside faces of alternate sprocket teeth was 60 degrees, as illustrated in Fig. 1, and that the formula for determining the pitch diameter was

$$PD = \frac{P}{\sin\left(\frac{180°}{N}\right)}$$

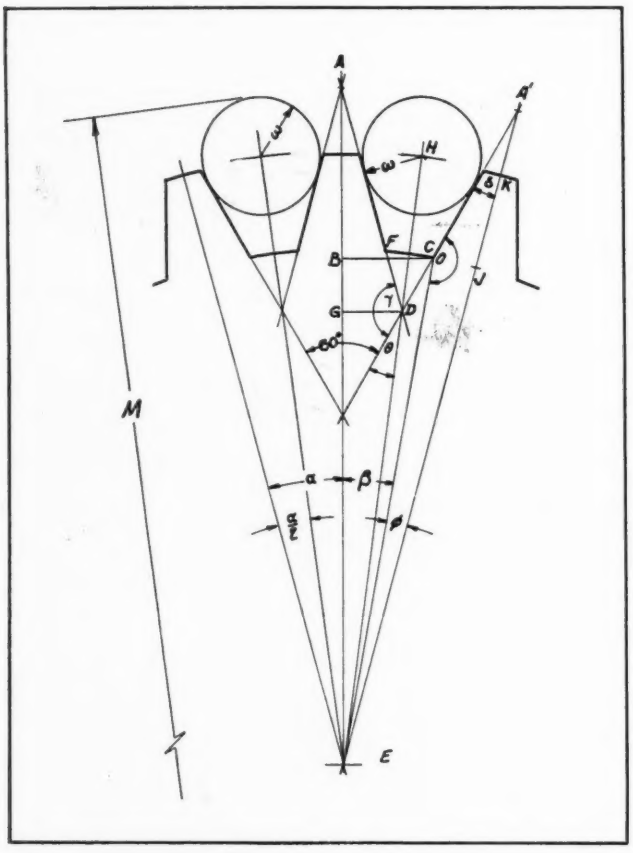


Fig. 1. In Addition to Known Data, the Information Required to Complete the Cutter Design Included the Angle ($\alpha \div 2$), the Width CF of the Bottom Face of the Cutter, and the Distance BC

where

PD = pitch diameter;
P = pitch, in inches; and
N = number of teeth in sprocket.

From a catalogue of the Morse Chain Co. were obtained standards of tooth depth, checking roll sizes, and roll measuring formulas, together with a list of pitch diameters and outside diameters for sprockets with various pitches and different numbers of teeth.

Other data needed to complete the cutter design were the angle $\frac{\alpha}{2}$ made by the bottom face of the cutter with a line parallel with the cutter axis; the width CF of the bottom face of the cutter; and the distance BC of the cutter point from the center line of the adjacent sprocket tooth.

The following formulas were used to determine these points:

$$\alpha = \frac{360 \text{ degrees}}{N}$$

$$\theta = 180 \text{ deg.} - \left(150 \text{ deg.} + \frac{\alpha}{2}\right)$$

or

$$\theta = 30 \text{ deg.} - \frac{\alpha}{2} = 30 \text{ deg.} - \frac{180}{N}$$

Referring to the diagram Fig. 1,

$$M = PD + \text{roll diameter}$$

where M = measurement over rolls and the center of the rolls lies on the pitch circle.

$$HD = \omega \operatorname{cosec} \theta$$

where ω = radius of roll.

The radius ED to the root apex point is

$$ED = EH - HD$$

$$EG = ED \cos \frac{\alpha}{2}$$

$$GD = ED \sin \frac{\alpha}{2}$$

$$\gamma = 180 - 2\theta$$

and

Drives with One Pair of Cutters

$\delta = 180 - (\gamma + 30 \text{ deg.})$ or $2\theta - 30$ degrees

Then

$$GA = GD \cot \delta$$

$GA + EG = EA$ (radius to outside apex point)

In triangle ECA',

$$\sin O = \frac{EA' \sin \delta}{EC}$$

and

$$\phi = 180 - (O + \delta)$$

$$\beta = \alpha - \phi$$

$$CB = EC \sin \beta$$

$$CF = 2\left[EC \sin\left(\beta - \frac{\alpha}{2}\right)\right]$$

It should be noted that as the number of teeth increases, the angle δ increases and the chord CF decreases in length. Since the chord CF, the angle it makes with the line EA, and the depth of the cut determine the maximum width of the cutter and the angle at its point, a compromise has to be reached on the cutter width in order to keep the inside corner of the cutting edge from nicking the side of the adjacent tooth on the sprocket during the cutting of the teeth. This is not too serious a compromise, inasmuch as the cut made by one cutter will overlap that made by the other when the blank is indexed to cut the second tooth. The angle $\frac{\alpha}{2}$ between the bottom face of the cutter and a line parallel with the cutter axis should be chosen for the smallest number of teeth to be cut—thirteen teeth if the cutter is to be used as an all-purpose cutter.

The chart Fig. 2 gives all the necessary data for constructing a cutter to machine sprockets having from 13 to 125 teeth and a pitch from 3/8 to 0.9 inch. It is apparent from this chart that with a pair of cutters of sufficient thickness to cut the entire face of the 30-degree angular side, and with a point width not greater than the

N Teeth	P Pitch	α $\frac{360}{N}$	θ $30° - \frac{\alpha}{2}$	ω Radius of Roll	EH $\frac{\frac{P}{2}}{\text{Sin } \frac{180°}{N}}$	KJ Depth	HD $\frac{\omega}{\text{Sin } \theta}$	ED EH−HD	EG ED Cos $\frac{\alpha}{2}$	GD ED Sin $\frac{\alpha}{2}$	δ $2\theta - 30°$	GA GD Cot δ
13	3/8	27°41'33"	16°09'14"	.1435	.7835	.2250	.5158	.2677	.2599	.0641	2°18'27"	1.5899
	1/2	"	"	.1850	1.0445	.3000	.6650	.3795	.3685	.0908	"	2.2593
	.9	"	"	.3300	1.8805	.5400	1.1861	.6944	.6742	.1662	"	4.1239
40	3/8	9°00'00"	25°30'00"	.1435	2.3900	.2400	.3333	2.0567	2.0503	.1614	21°00'00"	.4204
	1/2	"	"	.1850	3.1865	.3200	.4292	2.7568	2.7483	.2163	"	.5635
	.9	"	"	.3300	5.7355	.5700	.7665	4.9690	4.9537	.3900	"	1.0156
125	3/8	2°52'48"	28°33'36"	.1435	7.4610	.2438	.3002	7.1608	7.1586	.1795	27°07'12"	.3506
	1/2	"	"	.1850	9.9485	.3250	.3870	9.5615	9.5585	.2397	"	.4681
	.9	"	"	.3300	17.9075	.5850	.6903	17.2172	17.2118	.4317	"	.8428

N Teeth	P Pitch	EA GA+EG	EK $\frac{OD}{2}$	EC EK−KJ	O Sin O = $\frac{EA \text{ Sin } \delta}{EC}$	ϕ 180°−(O+δ)	β $\alpha - \phi$	CB EC Sin β	$\beta - \frac{\alpha}{2}$	CF $2[EC \text{ Sin}(\beta - \frac{\alpha}{2})]$	Roll Dimen.
13	3/8	1.8483	.7500	.5250	171°51'04"	5°50'29"	22°31'04"	.2016	8°40'17"	.1583	.6285
	1/2	2.6279	1.0345	.7345	171°43'04"	5°58'29"	21°43'04"	.2718	7°59'00"	.2040	.6987
	.9	4.7981	1.8620	1.3220	171°35'50"	6°05'43"	21°35'50"	.4866	7°45'03"	.3566	.9135
40	3/8	2.4707	2.3885	2.1485	155°39'45"	3°20'15"	5°39'45"	.2120	1°09'45"	.0872	.6389
	1/2	3.3118	3.2025	2.8825	155°41'11"	3°18'49"	5°41'11"	.2856	1°11'11"	.1194	.7125
	.9	5.9693	5.7650	5.1890	155°39'12"	3°20'48"	5°39'12"	.5112	1°09'12"	.2089	.9381
125	3/8	7.5091	7.4610	7.2173	151°41'12"	1°11'36"	1°41'12"	.2124	0°14'48"	.0621	.6393
	1/2	10.0266	9.9705	9.6455	151°42'53"	1°09'55"	1°42'53"	.2886	0°16'29"	.0925	.7155
	.9	18.0546	17.9485	17.3635	151°42'21"	1°10'11"	1°42'21"	.5176	0°15'57"	.1611	.9444

Fig. 2. Required Data for Designing Cutters to Machine Sprockets Having from 13 to 125 Teeth and a Pitch from 3/8 to 0.9 Inch

smallest distance *CF* shown on the chart (say 0.05 inch), it would be possible to cut any sprocket having up to 125 teeth and a linear pitch up to 0.9 inch by simply inserting different spacers as shown in Fig. 3, and removing the lip of metal left between the teeth as a secondary operation. Of course, if a known range of pitches and teeth are to be cut, it may be possible to adjust the point width of the cutter so as to eliminate this secondary operation.

The column marked "Roll Dimension" in Fig. 2 is the dimension from the center line of the spacer to the outside of a 0.3125-inch diameter roll. This dimension is indicated in Fig. 4.

In setting up a pair of cutters on a milling machine, the first step is to choose a spacer of the proper thickness to obtain the roll dimension shown in Fig. 2. When this roll dimension is maintained, the depth of the cut will be very close to the dimension shown in column *KJ* and the required measurement over the rolls ($M = PD + 2\omega$ for an even number of teeth) will be obtained without having to make too many trial cuts.

In order to adjust the cutter setting so that all the sprocket teeth are accurately spaced, a trial cut should first be made—say, to one-half the tooth depth. Then the sprocket blank is indexed 90 degrees and an indicator and surface gage set up to indicate zero on one of the flats made by the straight side of the cutter. The sprocket is now indexed again—this time 180 degrees—and the surface gage is moved around to the other side of the blank, where another reading is taken on the other flat.

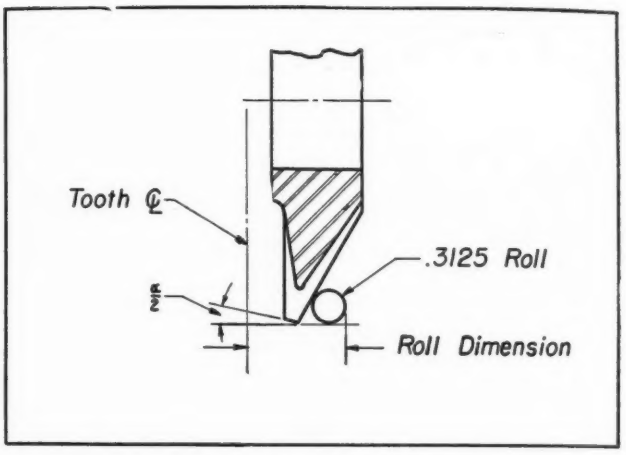


Fig. 4. Sketch Indicating the Roll Dimension Used to Grind a Cutter and Determine Spacer Thickness for Cutting the Teeth in Sprockets

If the indicator reads zero for both flats, the cutters are correctly set; if there is a difference in the indicator reading, the cross-slide of the milling machine should be moved a distance equal to one-half the difference in the indicator readings and in such a direction that it tends to reduce this difference. Another trial cut is now made and the cutter setting checked and adjusted until the spacer between the cutters is exactly on center.

It is a good plan to "double index" when using this type of cutter because of the tendency to crowd the part around on the mandrel when one cutter is cutting into solid stock and the other is finishing the side of the tooth. With an odd number of teeth in the sprocket, it is necessary to index only twice around the blank to cut all the teeth, while with an even number of teeth, it is necessary to double-index once around, single-index for one tooth, and then continue to double-index until all the teeth in the sprocket have been cut.

The data here presented is meant only as a guide to the maintenance man in an emergency, and it is not to be construed as applicable for all types of chain. While the sprockets cut according to the procedure described in the foregoing do operate well with Morse and Link-Belt chains, an effort should, of course, be made to use standard sprockets whenever it is possible to do so.

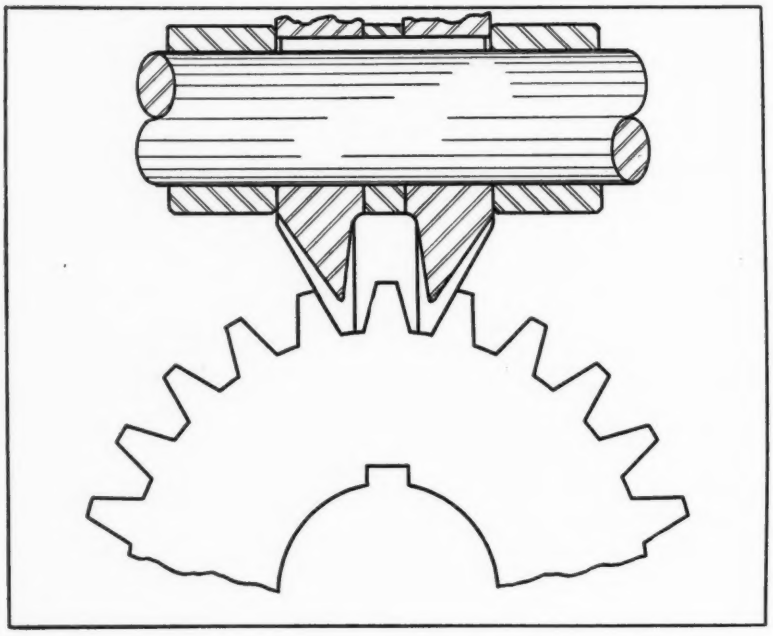


Fig. 3. Method of Setting up a Pair of Cutters on a Milling Machine. By Changing the Spacer between the Cutters, it is Possible to Cut Sprockets Varying in Pitch and Number of Teeth

Improved Method of Reproducing Engineering Drawings

Use of a New Positive Reproduction Paper and Automatic Blueprinting Machines has Reduced Printing and Processing Costs at General Motors

Fig. 1. Completely Finished Kodagraph Autopositive Paper Prints are Turned out at the Rate of 4 Feet per Minute on Machine Shown in Figs. 2 and 3

THE importance of using intermediate prints to protect original engineering drawings from loss, wear, and damage has long been recognized, and has encouraged the development of fast, economical methods of reproducing drawings. A photographic paper recently brought out by the Eastman Kodak Co. enables drawings to be reproduced without the expense of negatives and the delay of dark-room exposures. The material, known as Kodagraph Autopositive paper, is a photographic silver-sensitized paper which yields a positive copy from a positive original drawing without a negative step. The paper can be handled in ordinary room light, and it reproduces opaque as well as translucent drawings, retaining fine detail and providing a lasting copy.

Fig. 2. Automatic Blueprinting Machine Installed at General Motors Photographic for Processing Autopositive Paper Prints

Normal photographic processing, which includes developing, fixing, and washing, furnishes a positive print from which duplicates can be made on either direct-process or blueprint paper. The new material permits the economical use of photographic intermediate prints on an extensive scale. The elimination of redrawing unprintable drawings and the ease with which corrections can be made from the intermediate prints are among the advantages of this new paper.

General Motors Photographic, Detroit, Mich., has recently installed equipment to facilitate the use of this paper. The equipment consists of an automatic blueprinting machine developed by the Paragon-Revolute Corporation of Rochester, N. Y. Completely finished prints, as illustrated in Fig. 1, are turned out at the rate of 4 lineal feet a minute on this machine (see Figs. 2 and 3). Several divisions of the General Motors

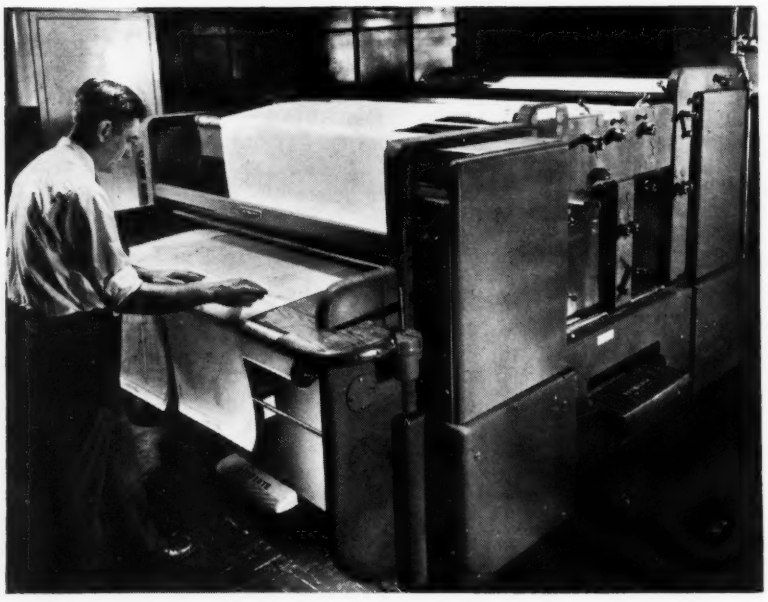


Fig. 3. General View of Paragon-Revolute Automatic Blueprinting Machine Shown in Fig. 2

Corporation are supplied with reproductions of their engineering drawings from this equipment.

Originally designed to produce blueprints, blueline prints, Van Dyke negatives, sepia negatives, and black and white direct-process prints by a continuous process, features were incorporated in the machine which would permit the continuous processing of photographic materials.

The quartz lamp normally furnished for blueprinting and exposing slow-speed materials is too powerful for Kodagraph Autopositive paper to permit operating at speeds practicable for continuous processing. The unit at General Motors Photographic is therefore equipped with a less powerful light source.

To provide light of the correct power, a filter is mounted inside a glass printing cylinder. Exposure is regulated by a printing light shade control, thus making possible operation at a constant speed to assure adequate developing, fixing, and washing.

The use of the automatic equipment described has resulted in important reductions in printing and processing costs at General Motors.

Allegheny Ludlum Completes Fifty Years of Steel Finishing

AN open house, held recently at the West Leechburg, Pa., plant of the Allegheny Ludlum Steel Corporation, commemorated fifty years of steel finishing. This plant was among the first to roll steel into strips. A 12-inch hot mill, installed in 1901, was producing the widest, thinnest steel strip made up to that time.

Slabs or billets of semi-finished carbon, stainless, or special alloy steel are produced on blooming rolls from electric and open-hearth ingots at the Brackenridge plant of the corporation. Such slabs are then hot- and cold-rolled to the desired specifications at the West Leechburg plant.

After removing imperfections from the surface of the slabs by grinding, the slabs are heated to about 2100 degrees F. before placing them on the 12- or 16-inch hot mills. In a typical reduction in these mills, a slab 3 inches thick by 10 feet long is converted into a strip 1/16 inch thick by 360 feet long.

As part of a $24,000,000 plant improvement program, a 28-inch, four-stand, four-high cold mill has been installed. Continuous annealing and pickling lines soften and clean strip coming from this mill to permit further rolling on Steckel or other cold mills.

Additional steel finishing equipment employed includes scale breakers, slitters, edging rolls, flattening machines, shears, etc. One of the features of the plant is a completely equipped metallurgical laboratory. A small, fifteen tandem, cold strip mill, installed in 1904, is still in operation.

A similar celebration was held at the Dunkirk, N. Y., plant of the company to mark the fortieth anniversary of that plant.

How to Specify Magnetic Chucks

Construction, Operation, and Application of Principal Types of Magnetic Chucking Devices

By CHARLES D. BRIGGS
Chief Engineer
O. S. Walker Co.
Worcester, Mass.

ALTHOUGH standard magnetic chucks usually are available in only two forms—rectangular and circular—each of these models can be obtained with any of several different types of magnetic circuits, faceplates, and base arrangements. In order to specify and use a magnetic chucking device correctly, the basic operating principles and the advantages and applications of each type should be thoroughly understood.

A magnetic chuck consists primarily of a body, which contains the coils, and a faceplate, which is the magnetized element that holds the work; a third element—an auxiliary plate that fits over the faceplate—may be added, if necessary, to hold work of irregular shape. The chuck is made operative by the flow of electrical current through the coils, which sets up magnetic fields in the steel core, the resultant lines of force penetrating the faceplate and the work. The strength of these magnetic fields is proportional to the ampere-turns in the coils (the number of turns multiplied by the current flow in amperes); however, since the number of turns in the coil is fixed, the flux density actually is governed by the current flow.

The efficiency of the chuck is dependent on the ability of the iron or steel used in its construction to absorb magnetic flux. Some materials are capable of absorbing more flux than others before they become saturated. When any material reaches the saturation point, an increase in the current flow to the coils will not increase the flux density. Therefore, the pull exerted by a chuck is a function of the ability of the material in it to absorb magnetic lines of force.

The pull of the ordinary magnetic chuck varies from 140 to 175 pounds per square inch. In service, these values may differ considerably because the magnetic qualities of the material being held and the thickness of the part are also governing factors. For example, magnetic chucks cannot be used to hold non-ferrous parts or ferrous parts that have a high alloy content or contain large amounts of impurities. Thus, some stainless steels, particularly those in the

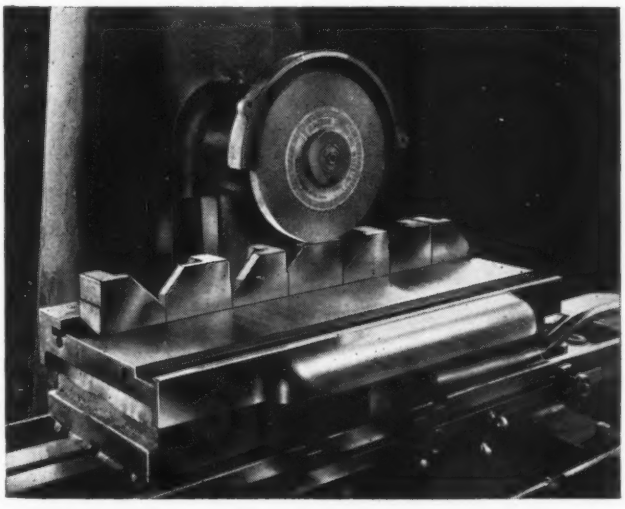


Fig. 1. The Set-up of Parts on Magnetic Chucks for Multiple Machining or Grinding Operations is Facilitated by the Use of Guide Bars on the Faceplate of the Chuck. End Plates are Required for Some Operations to Help Take up the Thrust

Types of Magnetic Chucks

Type of Chuck	Magnets	Magnetic Circuit	Faceplate				Type of Base
			Classification	Arrangement	Number of Faces	Shape	
Rectangular	Electric or Permanent	Straight Polarity Inductive Leakage	Standard Bar Pole Concentric-Gap	Longitudinal or Transverse Longitudinal or Transverse	Single or Multiple	Flat or Curved to Special Shape	Fixed Horizontal Fixed Vertical Apex Swivel Revolving Tapered Elevating
Circular	Electric or Permanent	Straight Polarity Inductive Leakage	Concentric-Gap Radial Pole	Spiral Wound Radial Pole Interlocking	Single or Multiple	Flat	Swivel Fixed Horizontal

300 series, and carbon steels with a high manganese content are difficult to hold.

Another factor affecting the holding power of a magnetic chuck is the mass of the part; thus, thin work cannot be held as well as thicker parts. When the thickness of a part is less than 1/32 inch, a chuck of special design must be employed or else the magnetic lines of force will penetrate, rather than flow through, the work. Pieces from 1/32 to 1/4 inch thick can be handled without difficulty, provided the operator takes care in setting up and in making the cut. This does not mean that thinner work cannot be chucked; as a matter of fact, work as thin as 0.005 inch can be held by the use of a special chuck.

After the coils of the chuck are energized, the flux density in the faceplate and the part rises to a maximum. But when the power is turned off, the flux does not return immediately to its zero value. Some of it remains in the part and in the faceplate. Although this residual magnetism gradually dissipates, it may hold the part with such force upon the finish of the machining operation that the part cannot be removed from the chuck, particularly if it is large and made of material having good magnetic properties.

To eliminate this difficulty, a reversing circuit is used on most chucks. This circuit changes the direction of flow of direct current, so that the polarity in the poles of the faceplate is changed. The lines of force thus flow through the faceplate and the part in the opposite direction, cancelling the residual magnetism.

Types of Magnetic Chucks

As previously mentioned, there are two basic types of magnetic chucks—rectangular and circular. The rectangular model can be obtained

Fig. 2. Revolving Type Chuck for Use on a Reciprocating - table Face Grinder Can be Loaded in the Horizontal Position and then Rotated to the Vertical Position for Grinding

with a faceplate having a standard pole, a bar pole, or a concentric-gap arrangement. These, in turn, with the exception of the concentric-gap chuck, can be obtained with the poles running in either a longitudinal or a transverse direction. The standard rectangular transverse chuck, with the division between the poles running across the faceplate, and the standard longitudinal chucks, with the divisions between the poles running parallel with the faceplate are the most commonly employed. The longitudinal chuck is used when the cut is across the work, and the transverse chuck when the cut is in the direction of the length of the work.

The transverse or longitudinal bar-pole chuck is a general all-purpose unit especially adaptable for small work. In such a chuck, the poles run to the edge of the faceplate, and a larger holding surface is obtained from the same size faceplate. The faceplate of these models is laminated, being composed of alternate strips of nonmagnetic material and steel bars.

As seen in the accompanying table, rectangular chucks in small and medium sizes are available either with electromagnets or with permanent magnets. The advantage of the latter units is that they can be used in shops where direct current is unavailable, or where facilities for converting alternating current are lacking. They are usually limited in size to a working surface of 8 by 24 inches or less, and thus can be applied only on relatively small jobs. Alnico permanent magnets are used in such applications, being so constructed that they can be rotated manually to bring the magnetic field within range of the faceplate. Rotation of the magnets in the other direction frees the work.

Electromagnetic chucks are usually specified if the chuck is to become a permanent part of a machine. Chucks for use on either 120- or 240-volt direct current are standard with most manufacturers, and models ranging in size from 4 by 8 inches to 30 by 96 inches are available; larger units can be obtained by special order. The wattage for these chucks varies from 27 for a small model to 1860 for the larger units.

The type of magnetic circuit that should be employed in the chuck can best be determined by the manufacturer. There are two circuits in general use—a straight-polarity circuit, in which there is a definite division between the poles of the chuck; and an inductive circuit, in which the polarity is obtained by induction of the magnetic flux. The inductive circuit is normally used for small thin parts, since its holding power is proportional to the mass of the parts. All parts act as one mass, and the greater the number of pieces on the chuck, the greater its holding power; the straight-polarity circuit is the most efficient, and is usually employed for general-purpose chucks.

A third type of circuit—but one seldom used—is the leakage circuit. It is the least positive and efficient, and is recommended only for holding thin or very small parts in special cases.

Rectangular magnetic chucks are available with several different base designs. The most common is the flat horizontal base shown in Fig. 1. Vertical chucks are also widely used, and are especially adaptable for face grinding or milling operations. Swivel bases can be specified when the work is to be held at an angle, and revolving, tapered, or elevating bases can be had. A revolving type unit is shown in Fig. 2.

Fig. 3. Circular Chucks are Adapted for Segmental-table Construction. Here a 72-inch Chuck Table is being Used for Surface-grinding Circular Disks. Table can be Manually Loaded or Fully Automatic

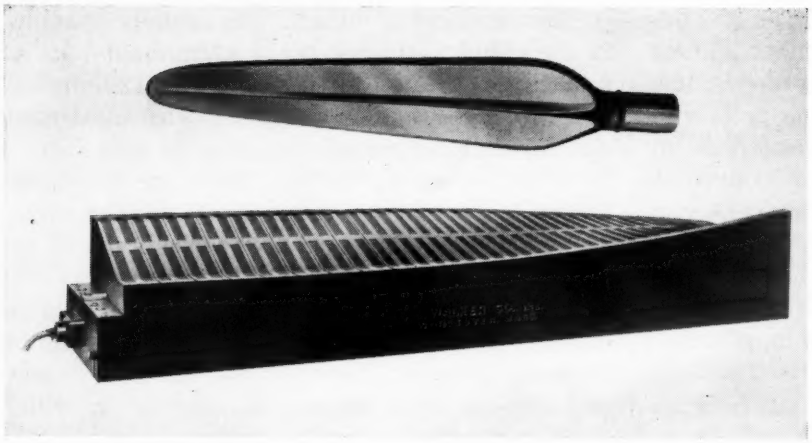


Fig. 4. Magnetic Chucks Having a Faceplate Shaped to Same Contour as the Part are Often Needed for Irregular Parts, such as the Airplane Propeller Blade Here Shown

Circular chucks are supplied in two types—concentric-gap and radial-pole. Concentric-gap units are used for general all-purpose chucking and for chucking small parts that are to be nested around the edge of the faceplate. A radial-pole unit is applied when one or two pieces must be chucked.

Magnetic chucks of the circular type lend themselves to a segmental-table construction, as shown in Fig. 3, particularly when applied to grinding machines. With such a table, the chucks are spaced around the periphery, each one being used to hold one part. This type of table can be made fully automatic in operation and simple unloading devices can be used, such as a fixed bar that pushes the part off the chuck when the power is removed.

Applications of Magnetic Chucks

Although magnetic chucks have been more widely used on grinding machines than on other machine tools, they have been applied in increasing numbers on milling machines, shapers, planers, and boring mills in recent years. The principal advantages of their use are: (1) Set-up time can be greatly reduced; (2) odd-shaped parts that are impossible to hold in mechanically or hydraulically operated chucks can be held by using an auxiliary plate having the same contour as the work surface; (3) a large number of parts can be nested on the same chuck for multiple machining or grinding; and (4) fragile parts can be held that otherwise could not be chucked without distortion.

Spectrographic Accessories Aid Material Analysis

FIVE new accessories for use in spectrographic analysis—a densitometer, a spectrum-plate projector, a safety arc and spark stand, an electrode shaper, and a briquetting press—have been developed by Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y. All of these accessories may be used with any spectrograph, regardless of make or design.

The densitometer permits direct reading and continuous recording of the density of the lines in an analytical spectrum for determining quantitatively any element present in the specimen. The spectrum-plate projector aids identification of unknown elements in any specific material or specimen. A special mirror arrangement throws the spectral image on a screen built into the projector or on a wall screen when greater magnification is desired for observation by a group.

To insure complete protection in using the dangerously high voltages (2 to 10 amperes at 110 to 15,000 volts) needed to burn the specimen in the arc for spectrographic analysis, the safety arc and spark stand was developed. The live parts of the circuit are encased in a cylindrical chamber. Thoroughly insulated, the chamber is inaccessible from the outside except by means of a door, the opening of which automatically breaks the electric circuit.

Resembling a miniature lathe, the electrode shaper has a rotatable turret equipped with adjustable cutters, drills, and tools for shaping graphite rods into the various standard electrodes used as arc and spark excitation sources.

The briquetting press compresses powdered drugs, chemicals, plant ashes, drill chips, hacksaw dust, and the like into pellets about the size of an aspirin tablet. The pellets can then be easily introduced into the graphite rods prepared on the electrode shaper for burning in the arc and spark stand. Operated manually, little effort is required to produce pressures up to 16,000 pounds to compress the material into pellets.

Proposed Gage Manufacturing Tolerances

By GILBERT A. MARSHALL

IN the pioneering days of industry, there was little need for standards, since manufacturers were independent of each other. Today practically every manufacturer depends on others to supply him with various finished goods. The more industry works together and manufacturers become dependent on each other, the greater the need for standardization.

At the present time, there is no universal standard for gage manufacturing and wear tolerances. A set of standards known as the "Gage Makers Tolerances" has been in existence for many years, but these standards did not prove satisfactory and have been almost completely discarded by industry. This system divides gages into classes, such as precision lapped, Class X; lapped finish, Class Y; and ground finish, Class Z. In each of these classes a tolerance is set for a certain range of sizes, irrespective of the tolerance on the work. No wear allowances are made. The direction of the tolerance has been quite indefinite, some users choosing to add all or part of the tolerance to the nominal size, while others subtracted it from the specified dimension.

The absence of a well defined gaging standard often results in excessively high rejections and increased production costs. In order to establish a satisfactory system of standards, a thorough analysis of the problem is necessary. This article is presented as an introduction to the problem, and by no means should be considered a complete analysis.

For example, there are several minor problems that have a definite bearing on any system of gage standards. Most of these problems reduce the effectiveness of standards only as far as any individual company is concerned. Such problems include temperature variations, improper care and maintenance, and practicability of gage design.

Table 1. Preferred Basic Sizes for Engineering and Manufacturing, Inches*

	0.0100	5/16	0.3125	1 7/8	1.8750
	0.0125	3/8	0.3750	2	2.0000
1/64	0.01562	7/16	0.4375	2 1/8	2.1250
	0.0200	1/2	0.5000	2 1/4	2.2500
	0.0250	9/16	0.5625	2 3/8	2.3750
1/32	0.03125	5/8	0.6250	2 1/2	2.5000
	0.0400	11/16	0.6875	2 5/8	2.6250
	0.0500	3/4	0.7500	2 3/4	2.7500
1/16	0.0625	7/8	0.8750	2 7/8	2.8750
	0.0800	1	1.0000	3	3.0000
3/32	0.09375	1 1/8	1.1250	3 1/4	3.2500
	0.1000	1 1/4	1.2500	3 1/2	3.5000
1/8	0.1250	1 3/8	1.3750	3 3/4	3.7500
5/32	0.15625	1 1/2	1.5000	4	4.0000
3/16	0.1875	1 5/8	1.6250	.....	.....
1/4	0.2500	1 3/4	1.7500	.....	.....

*Recommended in "American Standard Limits and Fits for Engineering and Manufacturing (Part I)", A.S.A. (B4.1—1947).

Table 2. Tolerances and Allowances for Engineering and Manufacturing, Inch*

0.0001	0.0006	0.0025	**0.0100**
0.00015	0.0008	0.0030	0.0120
0.0002	**0.0010**	0.0040	0.0150
0.00025	0.0012	**0.0050**	**0.0200**
0.0003	0.0015	0.0060	0.0250
0.0004	**0.0020**	0.0080	**0.0300**
0.0005			

Numbers in bold face are preferred values.

*Recommended in "American Standard Limits and Fits for Engineering and Manufacturing (Part I)", A.S.A. (B4.1—1947).

A system of fits between cylindrical parts that gives preferred basic sizes, tolerances, and allowances is a standardization which definitely affects the establishment of gage tolerances. For example, to fit a 1-inch diameter nominal size shaft into a hole with a minimum clearance of 0.0005 inch and a maximum clearance of 0.002 inch, the shaft might be made 0.9995 inch with a —0.0005 inch tolerance, and the hole 1.000 inch with a + 0.001 inch tolerance. Or the shaft could be made 0.9999 inch —0.0006 inch and the hole 1.0004 inch + 0.0009 inch.

It is evident that a great many combinations of shaft and hole dimensions would give the desired results. By using standards such as those recommended in the "American Standard Limits and Fits for Engineering and Manufacturing (Part I)," American Standards Association B4.1-1947, the number of dimensional combinations possible can be minimized and the number of gages required can be greatly reduced. Tables 1 and 2 list the preferred basic sizes, tolerances, and allowances given in this standard.

The greatest hindrance to gage tolerance standardization is the use of duplicate gages, or inspection and working gages. Many arguments and much lost time, as well as a great deal of scrap, have resulted from the fact that two gages, supposedly identical, do not agree. Of course, if one gage is outside the prescribed limits it should be discarded, but two gages, both

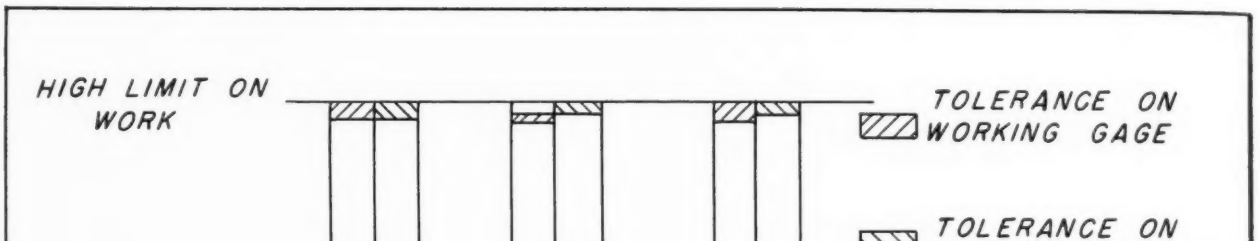


Fig. 1. Variation in Tolerances between Working and Inspection Gages for Different Conditions

within prescribed limits, can still cause trouble if one gage is near the high limit and the other near the low limit. The problem is to establish tolerances that are practical to maintain in manufacture and that eliminate the question of which gage has the final approval.

Probably the majority of manufacturers today make no distinction between working gages and inspection gages other than marking, and both gages are maintained to the same tolerances, as illustrated at *A* in Fig. 1. This condition allows practically an even chance of the inspection gage rejecting work passed by the working gage. This system, however, offers a minimum of difficulty in maintaining gage manufacturing tolerances.

In applying the suggested cylindrical plug gage tolerances given in Table 3 to a 1-inch diameter, Class 2 (+ 0.001 inch tolerance) hole, the "Go" gage would measure between 1.00000 and 1.00020 inches, and the "Not Go" gage from 1.00090 to 1.00100 inches. These dimensions include allowance for gage wear and apply to both working and inspection gages.

It is a generally accepted principle that the inspection gage should be maintained so that it will always pass work passed by the working gage. In this respect, it would be ideal to follow the condition illustrated at *B* in Fig. 1. In this system, the margin provided between working gage limits and work limits becomes the tolerance of the inspection gage. This eliminates the possibility of the inspection gage rejecting work passed by the working gage, but presents another problem. Either the manufacturing tolerances of the gages must be extremely small or an excessive portion of the total work tolerance must be sacrificed.

Of course, it is desirable for the operator to have as large a work tolerance as possible. Theo-

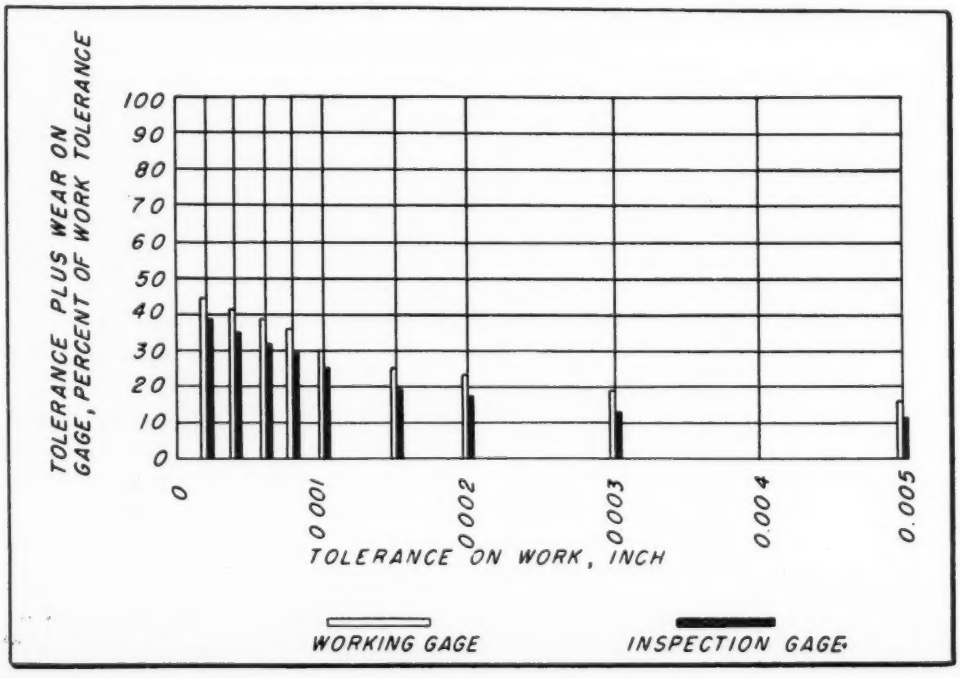


Fig. 2. Suggested Working and Inspection Gage Tolerances for Various Work Tolerances

retically, the operator should be allowed a tolerance of 0.001 inch if the hole is, say, 1.000 + 0.001 inch. However, this can very seldom be done. For this system, the "Go" working gage might be made between 1.00010 and 1.00020 inches and the "Go" inspection gage between 1.00000 and 1.00010 inch. Similarly, the "Not Go" working gage might be made from 1.00090 to 1.00095 inches in diameter, and the "Not Go" inspection gage between 1.00095 and 1.00100 inches.

A compromise between these two systems is illustrated at *C* in Fig. 1. This plan has been used for thread gages and has proved quite satisfactory. This method provides no margin, or a very small margin, between working gage limits and work limits. However, it does provide a smaller tolerance on the inspection gage than on the working gage. This reduces the possibility of the inspection gage rejecting work passed by the working gage.

Tables 3 and 4 are intended to apply to working gages only. It is suggested that the tolerances for inspection gages be approximately 75 per cent of these values. The values should probably be more than 75 per cent of the working gage tolerances on small sizes and less on larger ones. A chart showing the comparative inspection and working gage tolerances for different work tolerances is given in Fig. 2.

With this plan, using the same size hole, the "Go" working gage would be from 1.00000 to 1.00020 inches in diameter and the "Go" inspection gage between 1.00000 and 1.00015 inches. "Not Go" working gages would be from 1.00090 to 1.00100 inches and "Not Go" inspection gages from 1.00092 to 1.00100 inches.

It is very difficult with equipment available at the present time to measure small internal dimensions accurately. Therefore, it is desirable to set snap gages by means of disks instead of trying to measure the gage directly. This, however, requires the maintenance of reference disks to check both the high and low limits of "Go" and "Not Go" gages. These disks must have manufacturing tolerances also, which presents another problem requiring a great deal of study. Table 4 gives values for the gage itself, not for the reference disks.

There is a question as to the practicability of using fixed gages for checking dimensions with very small tolerances. The term "fixed gage" applies to any gage whose size, within a certain tolerance, is predetermined and is not adjusted to fit the particular piece of work in hand. With such gages, it becomes increasingly difficult to maintain gage manufacturing tolerances for small work tolerances without consuming most of this work tolerance on the gage itself.

Another aspect of the same question deals

Table 3. Cylindrical Plug Gage Tolerances*

Total Tolerance on Work	"Go" Gage		"Not Go" Gage	
	New	Worn out	New	Worn out
+ 0.0002	+ 0.00005 + 0.00002	+ 0.00000	+ 0.00020 + 0.00018	+ 0.00016
+ 0.0003	+ 0.00008 + 0.00004	+ 0.00000	+ 0.00030 + 0.00027	+ 0.00025
+ 0.0005	+ 0.00012 + 0.00006	+ 0.00000	+ 0.00050 + 0.00046	+ 0.00042
+ 0.001	+ 0.00020 + 0.00010	+ 0.00000	+ 0.0010 + 0.00095	+ 0.00090
+ 0.0015	+ 0.00025 + 0.00012	+ 0.00000	+ 0.0015 + 0.00145	+ 0.00140
+ 0.002	+ 0.00030 + 0.00015	+ 0.00000	+ 0.0020 + 0.0019	+ 0.00185
+ 0.003	+ 0.00035 + 0.00020	+ 0.00000	+ 0.0030 + 0.00285	+ 0.00275
+ 0.005	+ 0.00050 + 0.00030	+ 0.00000	+ 0.0050 + 0.00480	+ 0.00470
+ 0.010	+ 0.00070 + 0.00040	+ 0.00000	+ 0.0100 + 0.0097	+ 0.00955
+ 0.015	+ 0.00090 + 0.00050	+ 0.00000	+ 0.0150 + 0.0144	+ 0.0140

*All values in inches.

Table 4. Snap and Flush-Pin Gage Tolerances*

Total Tolerance on Work	"Go" Gage		"Not Go" Gage	
	New	Worn out	New	Worn out
— 0.0002	— 0.00000 — 0.00002	— 0.00005	— 0.00016 — 0.00018	— 0.0002
— 0.0003	— 0.00000 — 0.00004	— 0.00008	— 0.00025 — 0.00027	— 0.0003
— 0.0005	— 0.00000 — 0.00006	— 0.00012	— 0.00042 — 0.00046	— 0.0005
— 0.001	— 0.00000 — 0.00010	— 0.00020	— 0.00090 — 0.00095	— 0.0010
— 0.0015	— 0.00000 — 0.00012	— 0.00025	— 0.00140 — 0.00145	— 0.0015
— 0.002	— 0.00000 — 0.00015	— 0.00030	— 0 00185 — 0.0019	— 0.0020
— 0.003	— 0.00000 — 0.00020	— 0 00035	— 0.00275 — 0.00285	— 0.0030
— 0.005	— 0.00000 — 0.00030	— 0.00050	— 0.00470 — 0.00480	— 0.0050
— 0.010	— 0.00000 — 0.00040	— 0.00070	— 0.00955 — 0.0097	— 0.0100
— 0.015	— 0.00000 — 0.00050	— 0.00090	— 0.0140 — 0.0144	— 0.0150

*All values in inches.

with the "feel" of a gage. Every user of the fixed type of gage bases his decisions on the "feel" of the gage. The need of this may not seem apparent, but is, nevertheless, a very real part of gaging. When the possible variation between gage and work becomes very small, this sense of feel also becomes small. Because of these facts, it is recommended that for ordinary use, a tolerance of 0.0005 inch should be the smallest inspected with fixed gages.

American Gear Manufacturers Association Holds Semi-Annual Meeting

TECHNICAL sessions of unusual interest were a feature of the semi-annual meeting of the American Gear Manufacturers Association, held at the Edgewater Beach Hotel, Chicago, Ill., October 25 to 27, inclusive. Papers relating to gear shaving and gear grinding were presented at two sessions of a symposium on gear finishing.

At the first session, gear shaving was discussed in the following papers: "Shaving of Fine-Pitch Gears," by Louis D. Martin, Eastman Kodak Co.; "Shaving of Medium-Pitch Gears," by Ben F. Bregi, executive engineer, National Broach & Machine Co.; and "Shaving of Coarse-Pitch Gears," by George P. Maurer, supervisor, gear precision, The Falk Corporation.

The three papers presented at the second session of the symposium were: "Grinding of Fine-Pitch Gears," by A. S. Beam, the Vinco Corporation, an abstract of which is presented on page 156 of this number; "Grinding of Medium-Pitch Gears" by D. W. Dudley, General Electric Co.; and "Grinding of Coarse-Pitch Gears by the Maag Process," by G. L. Dannehower, High Precision Products Co. L. J. Collins, General Electric Co., was moderator at both sessions.

"High-Speed Industrial Gear Drives" was the subject of a paper by J. B. Connell, Westinghouse Electric Corporation. Mr. Connell pointed out that although the use of gears in one form or another can be traced as far back as 330 B.C., high-speed gearing is a relatively recent development. High-speed gears were defined as gears enclosed in cases and operated at pinion speeds of 3600 revolutions per minute and higher, pitch-line speeds of 4000 feet per minute and higher, or journal velocities of 1500 feet per minute and higher. The paper discussed the design, manufacture, and application of such gearing and also gave considerable information pertaining to test results.

Another paper presented was "Hydrodynamic Transmissions," by John Swift, Engineering Research Department, Engineering Division, the Ford Motor Co. In this paper, Mr. Swift traced the history of hydrodynamic transmissions, discussed construction and principles of design, dealt at considerable length with the characteristics of the various transmissions, indicated the influence of these characteristics on performance, and outlined effects of the gearing on transmission performance.

The speaker at the luncheon was A. G. Bryant, president of the Bryant Machinery & Engineering Co., who recently returned from a visit to the European nations that are cooperating under the European Recovery Plan. He discussed the various factors retarding the purchase of manufacturing equipment that is necessary to guarantee economic recovery of those nations.

* * *

Carboloy Training School for Distributors

The Carboloy Company, Inc., Detroit, Mich., announces that the carbide training course, established several years ago for distributors of the company's products, has recently been expanded to provide for specialized training in sheet-metal dies made of carbide. The new training course is scheduled to be held for four one-week periods. The first two courses in the new series were held in September and October, and the third and fourth courses will begin on December 6 and January 24. The courses cover technical data on carbides and new developments in the application of carbide tools and in grinding methods and equipment, as well as selling techniques.

* * *

A survey recently completed shows that 90 per cent of all cities and towns having local passenger transportation systems are served by buses only, and that 2140 towns have no local mass transportation but depend on private automobiles or "shanks' mare."

Minimizing Vibration in High-Speed Punch Presses

MANY types of machine mountings are available for minimizing vibration, one of the most successful being a bonded rubber mounting. At the plant of Waldes Kohinoor, Inc., in Long Island City, N. Y., a vertical shear type rubber mounting made by the Lord Mfg. Co., Erie, Pa., has been applied to high-speed punch presses with such success that vibration and accompanying noise has been considerably decreased.

These machines, which are fully automatic and operate at speeds of over 1500 strokes per minute with a 1/8-inch stroke, are used to punch out commercial and industrial zipper fasteners from brass, aluminum, and other non-ferrous alloys. Originally they were bolted to the floor. In an effort to reduce some of the vibration, hard rubber pads were installed under each leg of the presses. However, rubber is a relatively incompressible material, and to secure proper deflection, a single compression type mounting must allow freedom for the flow or bulge of rubber. In order to obtain the necessary deflection, the mounting must be made so that it is soft in all directions. As a result, the hard rubber mounting while accomplishing some improvement, did not answer the problem.

Greater softness with increased comparative stability can be obtained with rubber that is stressed in shear. In addition to decreasing noises and vibration, these mountings, when applied to the presses, reduce wear of the bearings and consequently of the punch and die.

A general design of the shear type mountings is shown in Fig. 1. Changes of any dimension or of the rubber compound used can be made to suit particular conditions of loading or deflection. The axial load-carrying capacity of the shear type units vary from 200 to 1150 pounds, depending on the size. These mountings are very stable, as their resistance to radial movement is many times greater than their resistance to axial movement.

Under usual operating conditions, the rubber is stressed only in shear, resulting in efficient isolation of normal vibratory movement. During periods of shock or resonance, the snubbing washer and the rubber or end extension are forcibly brought into contact. This contact produces a localized compressible stress in the end extension of the rubber, which momentarily increases the spring rate of the mounting and prevents excessive movement.

Several factors enter into the selection of the mounting. First, the amount of isolation that is obtained is a function of the softness of the suspension; the greater the amount of deflection of the mounting, the greater is the amount of isolation secured, but the shorter the life of the mounting. Then, too, there is a limit as to the amount of deflection that can occur without affecting the operation of the machine.

High-speed Punch Press Supported on a Vertical Shear Type Rubber Mounting to Minimize Vibration

A hard floor, such as concrete, can take a harder mounting. Also, if the machine is high, a harder mounting must be used than on a machine that is supported close to the floor. Other equipment in the plant may govern the selection of the mountings; if the surrounding equipment is rugged and little affected by vibration, a stiffer mounting can be employed.

Engineers at the Waldes-Kohinoor plant plan to extend the use of flexible mountings to other high-speed presses that are not yet so equipped. They also are using a smaller mounting on inspection instruments to isolate them from building vibration.

* * *

Over a million persons now have jobs in firms manufacturing motor vehicles and parts in this country. This is 350,000 more than in 1941.

Shop Shots in New Non-Ferrous

Fig. 1. Keyways are Milled and Bores of the Axle Bearings for Diesel Locomotives are Finish-turned on These Machines

A FOUNDRY recently placed in operation at Meadville, Pa., by the National Bearing Division of the American Brake Shoe Co., can produce 200,000 pounds of non-ferrous castings per day. This production exceeds the combined capacities of four old plants, the operation of which has been discontinued.

The machine shop has a production-line set-up for Diesel-engine and other precision type bearings. Milling machines handle castings up to 11 feet long and 6 feet high. A 74-inch boring mill handles castings up to 82 inches in diameter. Machines employed to mill keyways and finish bores in the bearings are seen in Fig. 1. Axle bearings for Diesel locomotives are seen in the foreground. Fig. 2 is a general view of the machine shop.

In the foundry there are melting furnaces ranging in size from small crucible type floor furnaces, which handle heats as low as 100 pounds, to a large reverberatory furnace, which handles heats of 20,000 pounds. An ingot-mold conveyor is attached to the large furnace, permitting it to be used for producing ingots for the smaller furnaces, as well as for refining metals. Raw materials are weighed, classified, and stored in boxes for easy transportation to a mezzanine charging platform. The furnaces are charged through gravity loading chutes.

By means of a special cleaning room, Fig. 3,

Fig. 2. General View of Machine Shop where Non-ferrous Castings for Bearings, Structural Members, Gear Blanks, Etc., are Finished

National Bearing Foundry

sand is removed from both the inside and outside of the larger and more intricate castings with a stream of water and sand that operates under 1600 pounds pressure. In this way, the plant air is not contaminated with dust.

The new plant has a total of 185,245 square feet of well ventilated floor space, and employs 450 people. Some areas of the plant have as many as eight changes of air a minute, and others a change of air every ten or fifteen minutes, depending on the need. More than 50,000 patterns are stored in the plant. In Fig. 4, cores are shown being inserted in the core ovens for baking.

Provisions have been made in the foundry for a centrifugal casting department, which will be placed in operation in the near future. Phosphor-copper is produced, in both waffle and shot form, in another department of the plant. Phosphorous pentoxide fumes are collected by electrical precipitation and turned into phosphoric acid.

Included in the products of the foundry are copper castings for blast furnaces, electrode-holders, bronze and copper structural castings, Diesel-engine bearings, locomotive wearing parts and car bearings, babbitt metal, pump impellers and housings, gear blanks, and industrial manganese and aluminum-bronze structural castings weighing up to 30,000 pounds.

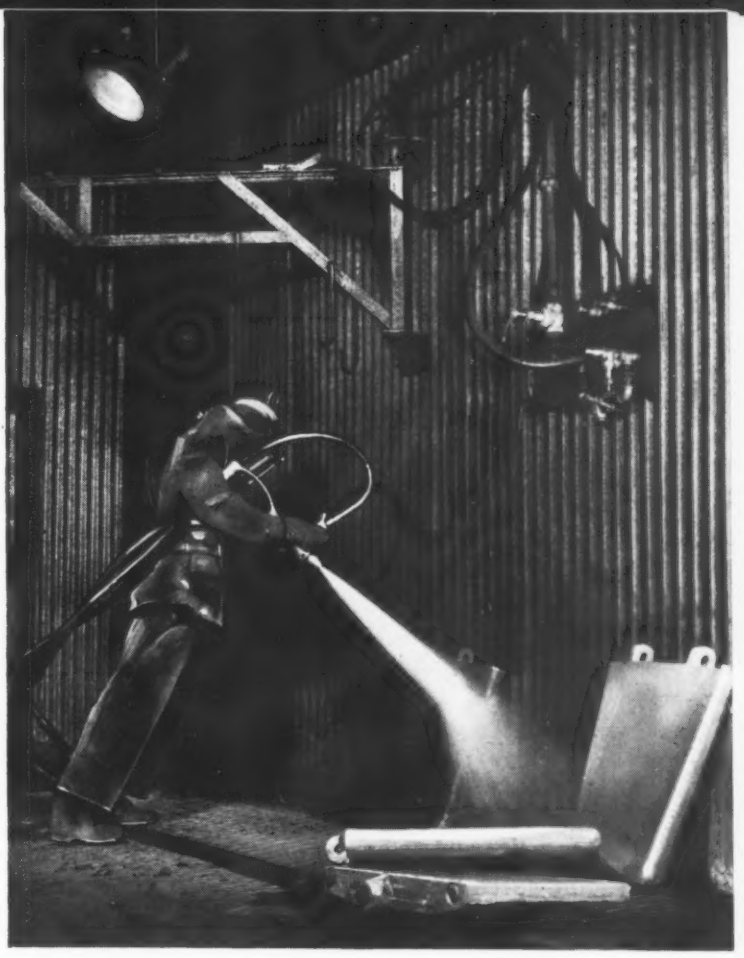
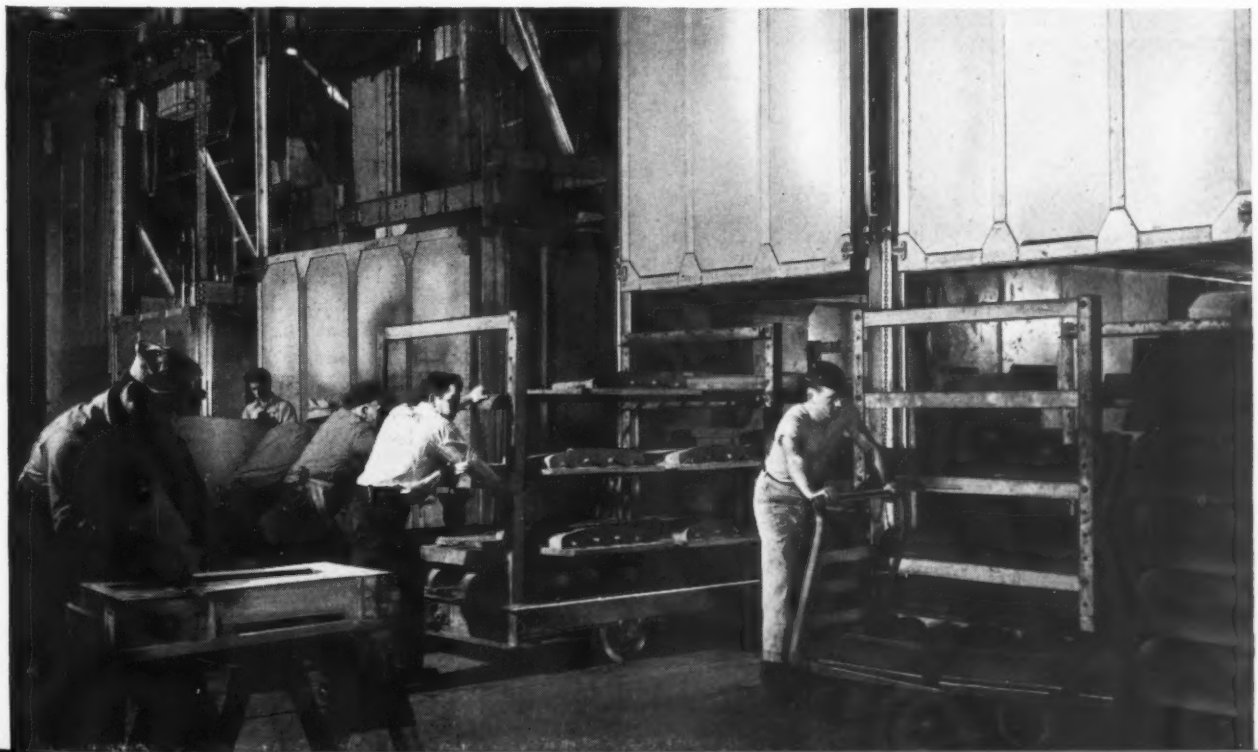


Fig. 3. Sand is Removed from Intricate Castings by Subjecting Them to a High-pressure Stream of Water and Sand

Fig. 4. Cores Stacked on Portable Racks are Transferred to One of Four Rack Type Ovens or a Car Type Oven for Drying



Cleaning System Speeds Output of Precision-Built Racing Motors

By H. R. KINGSLEY, Field Service Engineer
Turco Products, Inc., Los Angeles, Calif.

A CLEANING system for the removal of contaminating oils, grease, abrasives, chips, filings, and other foreign materials from Offenhauser racing motor parts has recently been installed in the Los Angeles plant of Meyer & Drake, builders of the engine. The compactness and versatility of this system make it adaptable for any shop engaged in the machining and assembly of precision metal parts.

There are more than seventy-five separate cleaning operations on the parts of each Offenhauser motor. After every machining operation, steel parts are washed in solvent to remove chips and cutting oils, while brass and aluminum parts are cleaned to remove chips. Likewise, each hand assembly operation requires individual cleaning.

Prior methods of cleaning were largely manual. Valuable time—often that of highly skilled labor—was lost because of the many time-consuming operations required. Two particularly difficult problems were the removal of aluminum chips and the cleaning of sand from rough castings, not only because these particles clung tightly to the surfaces, but also because casting recesses served to trap and hold them.

The new cleaning system removes these and other foreign materials quickly and with a minimum of effort. It consists of two separate units —a Turco solvent spray table equipped with both a solvent gun and an air-water spray gun; and a Turco "Turbulator" for cold tank cleaning. The cleaning tank is equipped with agitators that force the solvent through and around the parts. Nine distinct liquid flow actions result in completely cleaning inaccessible areas, such as blind holes.

The spray booth shown in Fig. 1 is of the enclosed type, preventing waste of over-spray, and occupies a minimum of floor space. Dirt and solvent enter a drain pan through slots in the hard-wood surface of the work grate, where a series of baffles and a settling tank remove solid dirt particles while clean solvent drains back into a reservoir for re-use. If an air-water spray gun is also used, however, as is general practice at this plant for cleaning aluminum and brass parts, re-use of the solvent is not practical, since the water would cause rusting of steel parts.

Cleaning Practice for Various Assemblies

The time required for cleaning varies with the type of part being handled and the substance being removed. A crankcase casting such as illustrated in Fig. 2 has about a dozen recessed areas. Any machining operation naturally results in an accumulation of chips in these recesses, and the trapped chips cling to corners,

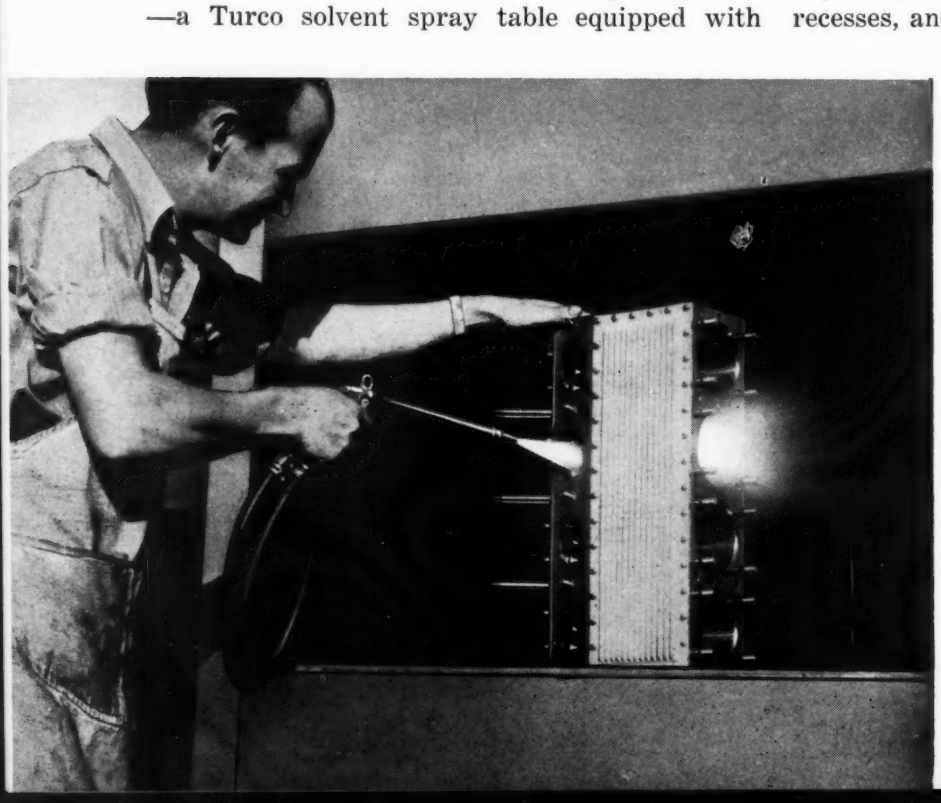


Fig. 1. The Solvent Spray Table is Enclosed to Save Over-spray, and is Equipped with Both an Air-water Gun for Cleaning Parts not Subject to Rusting and a Solvent Spray Gun for Ferrous Parts. A Semi-assembled 200-cubic-centimeter Aluminum Cylinder Block is Shown being Cleaned

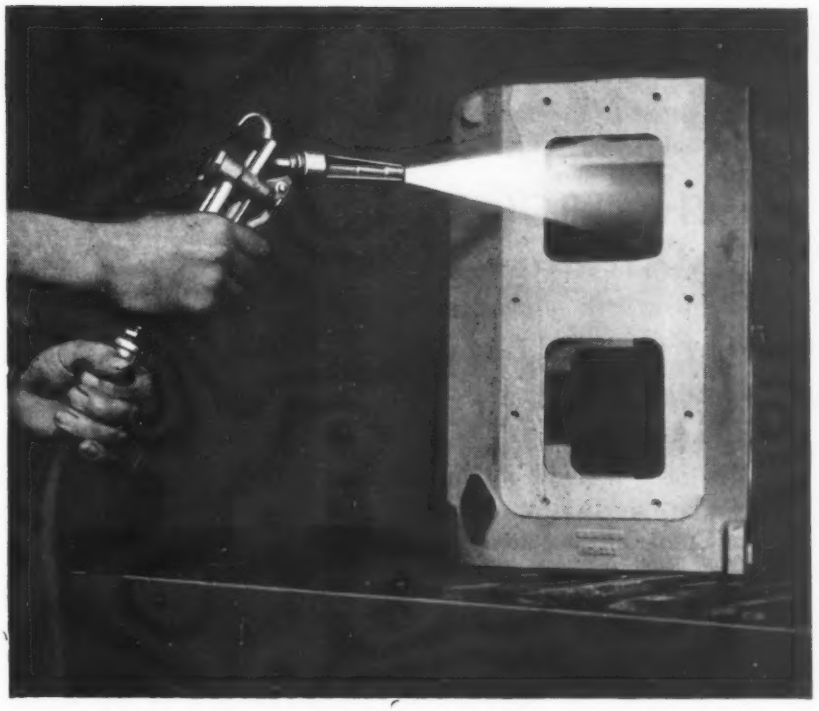


Fig. 2. Sand and Other Foreign Particles are Removed from Parts such as the Crankcase Shown by First Immersing the Part in the Cold Cleaning Tank, and then Removing the Loosened Material Either with the Air-water or Solvent Spray Gun

resisting removal. To clean, the crankcases are first immersed in the cleaning tank, and then placed on the spray table and blown with the air-water gun. They can usually be freed from all troublesome chips in less than five minutes. An advantage of this multiple cleaning method, which is used for all parts, is the removal of all sand particles and chips, some of which are likely to remain after ordinary cleaning.

Machined parts are stacked or racked for transportation to the cleaning tank. To lessen the rate of contamination in the cleaning compartment, parts are shaken or air-blown to remove large chips. Smaller particles, usually covered with cutting oil, cling tightly but are easily removed by the scrubbing action of the liquid flow. Heavy accumulations of oil or grease are not a problem, and parts remain in the solvent only long enough for removal of light cutting oil which bonds chips to the casting. Loosened particles still remaining on the parts are removed by the air-water or solvent guns. After the parts have drained for a few minutes, they are ready for further machining.

All small parts are racked in a basket before being immersed in the cleaning tank, as racking provides faster, more economical cleaning. Cup-shaped parts are racked so that the fluid flows over the inner and outer surfaces, to assure liquid-flow cleaning of both sides. Parts having hollow cores or machined openings are placed so that the fluid circulates through the openings.

An outstanding feature of the new system is its cleanliness. Since high standards of production require the cleaning of parts after each machining operation, it is important to avoid the messy floors frequently resulting from cleaning processes. The solvent spray table and the agitating tank are self-contained units, which not only furnish powerful cleaning solvent, but also provide suitable traps for dirt, chips, and oil. With this system, pleasant working conditions are maintained and slippery unsightly floors are eliminated.

* * *

Machine Developed for Printing on Cellophane Identifying Tape

Pressure-sensitive transparent tape, because of its quick adhesiveness and lasting qualities, was used over printed paper during the war to provide means for quickly identifying leads and terminals and for marking parts. Colored tape of this type was used for coding purposes. However, plain tape, even with printed paper underneath, was not wholly satisfactory and required too much time for its application. There were not sufficient colors available for coding purposes, and many more marking and code designations were necessary.

To meet this need, Clarence Krout, engineer of the Topflight Tool Co., Inc., York, Pa., built a machine from scrap materials picked up in the machine shop, for printing on transparent tape. The company now has about sixty tape printers in operation, no two of which are alike, each succeeding design being an improvement over the preceding model.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Sintered Carbide Developed for High-Speed Planer Tools

A sintered-carbide alloy especially designed for high-speed planer tools has been announced by the Carbide Alloys Division of Allegheny Ludlum Steel Corporation, Ferndale, Mich. The new alloy, which was developed with the cooperation of manufacturers of high-speed planers, is now available on a commercial basis under the trade name Carmet Grade CA-51, and the blanks can be supplied for planers on which either the clamped-in or brazed type blanks are used.

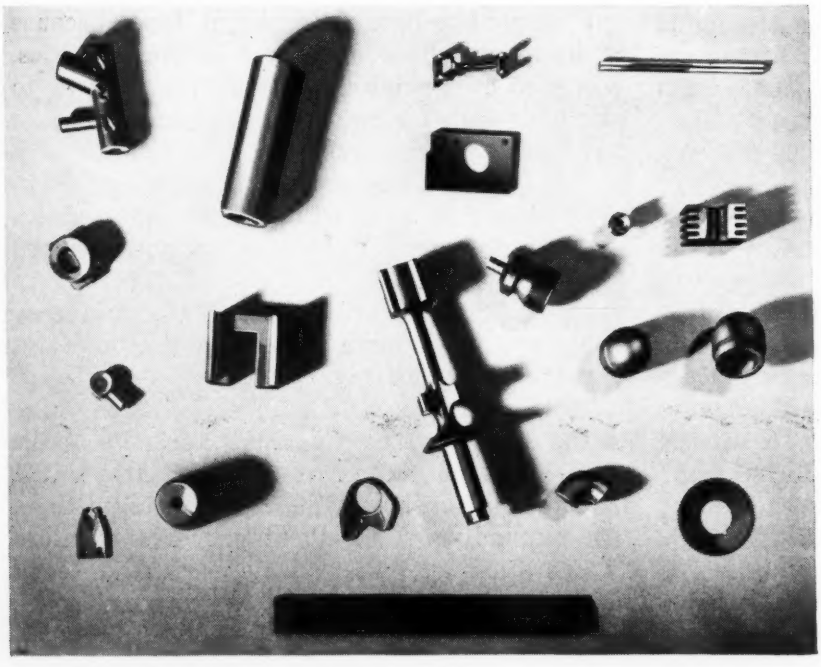
The following data were compiled from a typical test with a planer using clamped-in blanks: Material cut, 60 per cent semi-steel casting; depth of cut, up to 1 1/2 inches; feed, 0.100 inch; surface speed, 175 feet per minute. As much as 2100 pounds of metal was removed per grind of tool. The most economical metal removal was found to be 1750 pounds per grind. Other applications for the new alloy include tool blanks for heavy turning, boring, and facing, as well as for simliar operations where an exceptionally strong carbide is required. 201

Nylon in Strip Form Suitable for Valve Seats

Pliability combined with good wear resistance is the outstanding characteristic of a new form of nylon known as FE-1044, which is manufactured by the Polymer Corporation, Reading, Pa., in strips up to 2 inches wide. The new nylon has many of the properties of rubber, and in addition, excellent chemical resistance to hydrocarbons. Applications of the nylon strip include seating disks for low-pressure valves and gaskets which must remain flexible where contact with oil, gasoline, or various hydrocarbons is involved. 202

Cold-Solvent Material for Stripping Paint from Metal Surfaces

Oakite Products, Inc., 126 Thames St., New York 6, N. Y., has developed a cold-solvent material—Oakite Composition No. 15—designed to permit fast, thorough removal of paint and similar finishes from metal surfaces. This compound has proved to be effective in removing baking



Some of the Precision Castings of Intricate Design being Produced at International Nickel Co.'s Bayonne, N. J., Plant in a Range of Nickel Alloys, Including Austenitic Stainless Steels. Tolerances are Held within Plus or Minus 0.005 Inch per Inch of Casting

japans, wrinkle finishes, nitrocellulose lacquers, and synthetics such as alkyds, phenolics, ureas, vinyls, etc., from steel, galvanized iron, die-castings, aluminum, copper, brass, and similar metals, with no attack on the metal.

It is designed for use at room temperature, and may be applied by tank immersion or by swabbing or brushing. This is followed by a hot pressure rinse to remove loosened paint particles. An important use for this compound is in the production stripping of rejected parts. 203

Oil-Resistant Lacquer for Metal Surfaces

A metal lacquer for use where oil resistance, toughness, and maximum adhesion are required has been brought out by the Dennis Chemical Co., 2701 Papin St., St. Louis, Mo. This lacquer, known as Dennis No. 5062, will withstand twenty-four-hour immersion in gasoline and fifteen-minute immersion in hot oil (275 degrees F.) with no apparent deterioration in film strength or gloss. The coating has excellent adhesion to a variety of metal surfaces. 204

Carburit Casehardening Paste Offers New Approach to Heat-Treating

A paste that does a rapid casehardening job on steel without special equipment has been developed by Denfis Chemical Laboratories, Inc., 172 Pacific St., Brooklyn 2, N. Y. A major advantage of this paste, which is called "Carburit," is its ready application for selective hardening. The section to be hardened is covered with the paste and the work is heated to about 1700 degrees F. A case 0.010 inch thick is formed in five to seven minutes and only twenty-five to thirty minutes is required for a 0.040-inch case. After heating with the Carburit applied, the work is cooled and reheated to 1500 degrees F. Then the paste is removed and the work is quenched. The hardness produced in various irons and steels compares favorably with that obtained by other methods.

Any source of heat can be used with this casehardening paste. When a furnace is available, the heating can be accurately controlled, but a field forge or other means of heating will produce excellent results. The freedom from special equipment, combined with the speed of penetration, makes Carburit particularly suitable for repair work. 205

Waterproof Pulley Lagging that Can be Quickly Applied

The Condersite Engineering Corporation, 2015 Chancellor St., Philadelphia 3, Pa., has produced an all-purpose waterproof pulley lagging that is quickly and easily applied without rivets, bolts, or heat, and that dries within ten hours at room temperature.

This tough, wear-resistant, waterproof lagging adheres so firmly to all surfaces that a hammer and chisel are required to remove it. In addition, it is unaffected by weather conditions, and is resistant to corrosion by sulphuric acid, soaps, alcohol, and petroleum products.

It provides a superior frictional surface, which increases transmission efficiency and belt life by eliminating slippage, and is equally suitable for crown, split, or flat pulleys, and leather, cord, wire-woven, or rubber belts. 206

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on these pages, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in December, 1948, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on the blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

NAME.....**POSITION OR TITLE**.....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM.....

BUSINESS ADDRESS.....

CITY.....**STATE**.....

Collet-Chuck Spanner Wrenches Redesigned for Ease of Manufacture

By T. B. HALL
Hall Mfg. Co., Los Angeles, Calif.

SPANNER wrenches for removing collet chucks from lathe spindles are usually punched from strip stock in a die. However, this method is not too satisfactory, first, because the pin that carries the load must in many cases be round, and second, because die costs may be prohibitive if production schedules are low.

At the left of the accompanying illustration is shown a wrench for a 1-inch capacity chuck. This wrench was stamped from 1/8-inch strip stock with a die costing $150. The load pin was of rectangular shape, 1/8 by 1/4 inch in size, whereas the mating hole in the chuck was round and was 17/64 inch in diameter. Needless to say, the wrench was weak, and many units were broken in service.

The second wrench from the left was made to fit a 2-inch chuck. In order to obtain the needed strength, 1/4-inch stock was used. The die cost jumped to $600 with a corresponding increase in material cost because of the greater amount of scrap involved. This wrench had the same disadvantages as the model previously described, and so did a 3-inch wrench that was later added to the line.

To overcome these difficulties, it was decided to fabricate all wrenches from steel tubing and steel drill rod, as shown in the three views at the right of the illustration. The head was made from heavy-gage tubing of approximately the correct inside diameter. After a light boring cut was made on the lathe to obtain the best diameter for the inside of the wrench head, the tubing was cut into narrow widths on an automatic saw. The rings thus produced were then drilled at two points and sawed in half; thus, one ring made the heads for two wrenches. A hardened steel pin inserted in the drilled holes and a handle welded to each head with Lincoln-weld welding rod completed the assembly. The wrenches were finished by dipping them in paint.

On larger models, the total cost per unit did not exceed the cost of material for a stamped wrench, and the punching and die costs were eliminated. On smaller models, the costs were proportionately less.

* * *

Austin-Hastings to Hold Machine Tool Show

The Austin-Hastings Co., Inc., Cambridge, Mass., will hold a machine tool, welding, and metal-working equipment show in the Hartford Times Radio Center Building, 555 Asylum St., Hartford, Conn., on December 6 to 10, inclusive. The show will be open daily from 10 A.M. to 6 P.M., with the exception of Thursday, December 9, when it will be open until 9 P.M. Among the machines to be exhibited will be shapers, grinders, jig-borers, drilling machines, abrasive cut-off machines, engine lathes, press brakes, punch presses, and benders. Welding equipment to be shown will include arc-welding, oxy-acetylene welding, and resistance welding machines, as well as welding torches and electrodes. All machines will be demonstrated under power.

The Three Fabricated Spanner Wrenches for Collet Chucks, Shown at the Right, Proved to be of Better Quality and could be Made at Lower Cost than the Stamped Models Shown at the Left

Spacing Planetary Pinions

By VIC FRANCIS
National Broach & Machine Co.
Detroit, Mich.

INTERNAL planetary gearing systems have been known for many years, but their use has only become widespread in the last few years. The famed Ford Model T transmission was the best known use of the planetary system until recently. Its unique features, such as compactness and the fact that the output and input shafts were coaxial, caused it to be adopted by the aircraft engine industry for their final reduction units. Now, planetary gear sets are being used in many of the new automotive transmissions. The purpose of this article is to aid the machine designer in adapting planetary gear systems to other machine products.

It was once believed that the use of more than three planet pinions in a planetary gear set was of little value. This conclusion was based on the inaccuracies resulting from the gear-cutting methods then employed. Using only one planet pinion would cause the pinion to carry the entire load. Using two planet pinions, it can be assumed that both will carry half the load most of the time. Deflection of the teeth would more or less distribute the load properly between the two pinions. If three planets were used, there might be times when one carried less than one-third of the load because the other two were taking more than their share. With more than three planet gears, the assumption was that at least one would be carrying but little of the load most of the time and hence would be useless.

Today, with higher standards of accuracy more easily obtained by means of gear-shaving and other methods, it is possible to use many more than three planets in a set and thus increase the power-transmission capabilities proportionately. A good example is the planetary reduction unit of an aircraft engine. Each pinion that can be added to an accurate planetary set increases the capacity of the set by the capacity of that pinion.

In designing a planetary gear set, it is often found that the planet pinions cannot be evenly spaced on the planet-pinion carrier and still mesh with the internal and sun gears. Such a case would result from using a 58-tooth internal gear, a 28-tooth sun gear, and four 15-tooth planet pinions. Books on the design of this type of gearing contain rules specifying that if two planet pinions are desired, the sun gear and the planet pinions must both have either an even or an odd number of teeth. When three planets are desired, the number of teeth on each planet must be divisible by 3 if the number of teeth on the sun gear is divisible by 3. If the number of teeth on the sun gear plus 1 is divisible by 3, then the number of teeth on each planet minus 1 must be divisible by 3. Also, if the number of teeth on the sun gear minus 1 is divisible by 3, then the number of teeth on each pinion plus 1 must be divisible by 3. When four planet pinions are desired, the number of teeth on each planet must be even if the number of teeth on the sun gear is even, and the number of teeth on each planet must be odd if the number of teeth on the sun gear is odd.

All of these rules are necessary for the even spacing of gears, where the sum of the number of teeth on the sun gear plus two times the number of teeth on the planet pinion, equals the number of teeth on the internal gear. However, it is not necessary that the planets be evenly spaced; it is merely desirable that they be in such a position as to balance their rotating masses. Any unbalance places additional loads on the bearings when the gears rotate. To balance a planetary system, one pinion should be placed diametrically opposite another pinion for an even number of planet pinions, and the pinions should be evenly spaced for an odd number of planets. Therefore, it is possible to use any number of planets in a set, provided the planets do not interfere with each other.

While complete balancing is sometimes impossible, it is expedient to place the pinions as

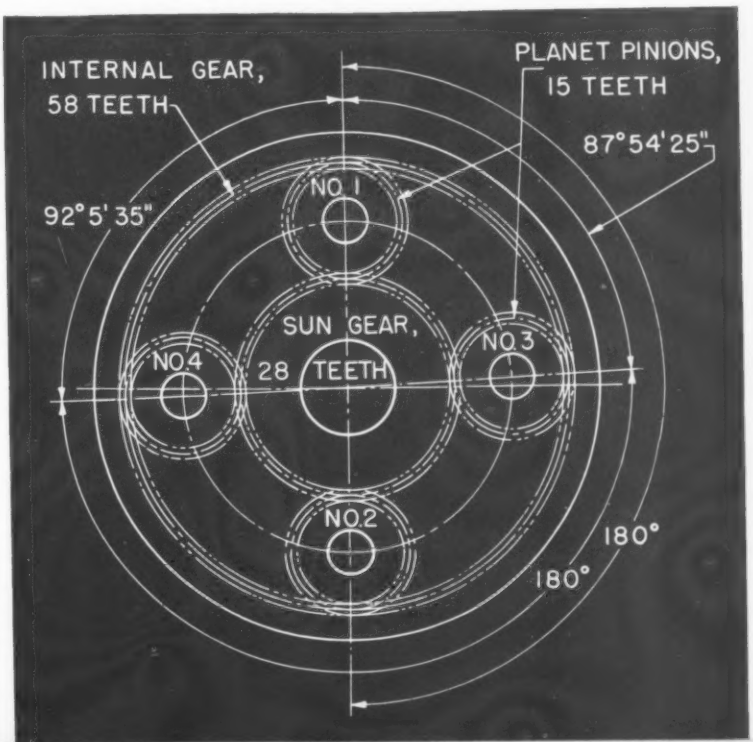


Fig. 1. Correct Spacing for Four 15-tooth Planet Pinions, Mounted between a 58-tooth Internal Gear and a 28-tooth Sun Gear

close to a balanced condition as possible. The application of the unit will determine whether this is practical or not. In the case of high-speed applications, the planetary set should be balanced. If the need for balancing is uncertain, it is best to compute the additional force imposed by the unbalance.

To find the angle at which the several planet pinions should be placed on their carrier, the following simple formula can be used:

$$A = \frac{360}{N_s + N_i} \times X$$

where

A = angle, in degrees, between planetary pinions;

N_s = number of teeth on the sun gear;

N_i = number of teeth on the internal gear;

and

X = a selected whole number that will give an angle A equal to, or closely approximating, that desired for balancing of the planetary gear set.

For example, suppose it is desired to employ four planet pinions in a set where $N_s = 28$; $N_i = 58$; and n (number of teeth on each planet) $= 15$. Then $\frac{360}{N_s + N_i} = \frac{360}{28 + 58} = 4.186047$.

For balance, one planet must be diametrically opposite, or at an angle of 180 degrees from, another planet. By dividing 180, or A, by 4.186047, it is found that X does equal a whole number, 43. Pinion No. 2 can therefore be placed 180 degrees from pinion No. 1, as shown in Fig. 1.

It is also desirable to place the other two pinions at angles of 90 degrees from the first two. By dividing 90, or A in this case, by 4.186047, it is found that X equals 21.5. However, since X must be a whole number, it can be made either 21 or 22.

Angle A can therefore be made equal to:

$21 \times 4.186047 = 87.90699$ deg. $= 87$ deg. 54 min. 25 sec.

or

$22 \times 4.186047 = 92.09303$ deg. $= 92$ deg. 5 min. 35 sec.

Thus, pinions Nos. 3 and 4 can be placed diametrically opposite each other (at an angle of 180 degrees), with No. 3 pinion at an angle of 87 degrees 54 minutes 25 seconds from No. 1, as shown in Fig. 1.

To use the formula, it is not necessary for the sum of the number of teeth on the sun gear plus two times the number of teeth on each planet pinion ($N_s + 2n$) to equal the number of teeth on the internal gear N_i. If the planet pinions are made over size to increase their strength, and the internal and sun gears are made either over size, under size, or standard, the formula can still be used.

For example, suppose a gear set employing five planet pinions is to be designed, in which the planets are to be made over size, the sun gear standard, the internal gear over size, the center distance greater than standard, and $N_s = 27$, $N_i = 74$, and $n = 23$.

It is desired to space the five pinions as evenly as possible. If they could be evenly spaced, they would be $\frac{360}{5} = 72$ degrees apart.

For use in the formula given for determining angle A, the quantity $\frac{360}{N_s + N_i}$ is calculated, and equals 3.56436. Then X will equal $\frac{A}{3.56436}$ or $\frac{72}{3.56436} = 20.2$. However, since X must be a whole number, the closest whole number (20) is taken. Then $A = 20 \times 3.56436 = 71.28720$ deg. $= 71$ deg. 17 min. 14 sec.

The No. 2 pinion is placed at this angle from planet pinion No. 1, as shown in Fig. 2.

For balance, No. 3 pinion should be located at an angle of two times 72 degrees, or 144 de-

(Concluded on page 193)

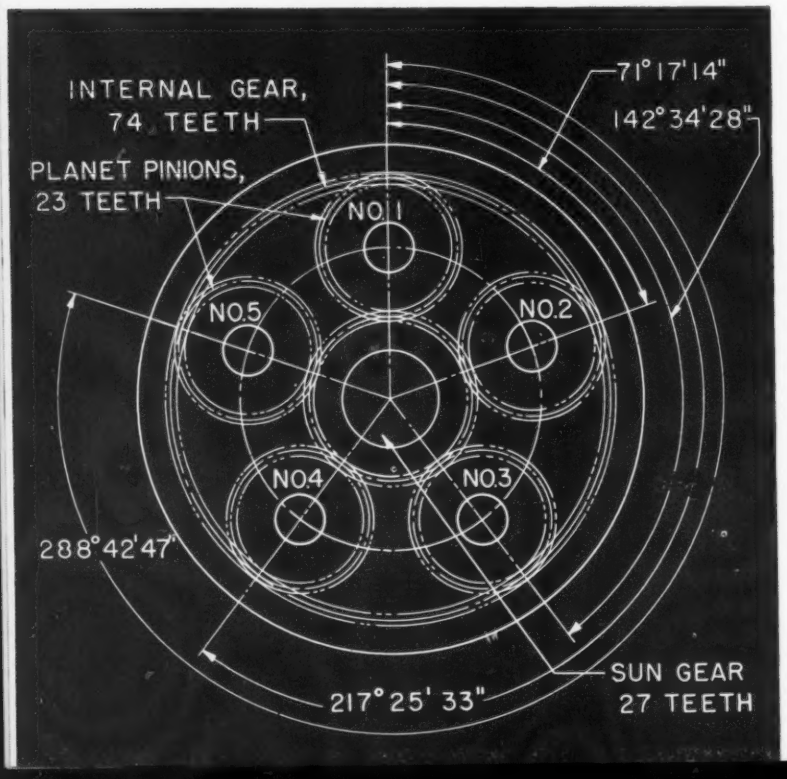


Fig. 2. Method of Spacing Five 23-tooth Pinions in a Planetary Gear Set Having a 27-tooth Sun Gear and a 74-tooth Internal Gear

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

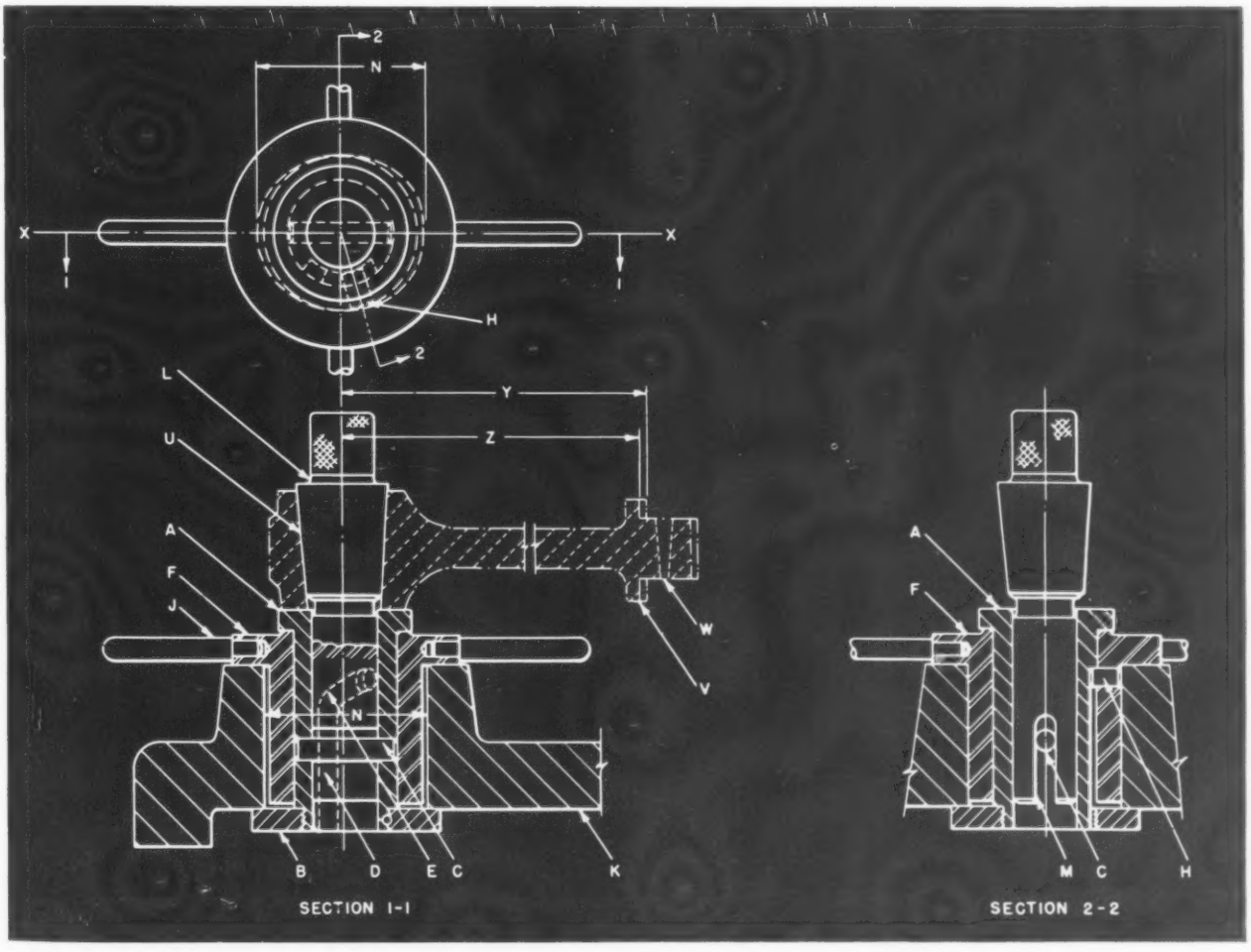
Fixture Designed for Radial and Axial Location

By F. SERVER, Pawtucket, R. I.

The fixture shown in the accompanying illustration was designed to position a connecting arm for drilling a tapered hole at varying distances along the axis of the arm. The position of the shoulder *V*, from which hole *W* is located, varied in different connecting arms, as indicated at *Y* and *Z* in section *1–1*. It was necessary, therefore, to provide a means of adjusting the work in the fixture to allow for this variation in dimension along axis *X* - *X* without affecting the alignment of hole *W* relative to the locating hole *U*. This was accomplished by providing an elongated bore *N* in the body of the fixture to permit the required axial adjustment.

The work, indicated by dot-and-dash lines, is located from the tapered hole *U*, and is positioned in the fixture *K* on the tapered portion of arbor *L*. The under side of the work clears by a slight amount, the top of shouldered bushing *A* which, together with the sleeve *F*, is held in place by means of threaded collar *B*.

The bushing is provided with a pin *C* that extends horizontally across the bushing and engages a slot *M* in the lower end of the arbor. This prevents movement of the bushing when



A Fixture Designed to Position Connecting Arms for Drilling a Variably Located Hole

turning the sleeve *F*. A short pin *H* extends through the wall of sleeve *F* and engages an angular groove *E* which is milled radially part way around the bushing *A*. In order to facilitate assembling of the bushing with the sleeve, a longitudinal groove *D* joins the angular groove in the bushing.

When putting the work in place, arbor *L* is slipped into position, with the slot *M* over pin *C*. Sleeve *F* is then turned clockwise, using one of the four pins *J* which are assembled in the flange of the sleeve. This actuates pin *H* in the angular groove *E*, causing a cam action which draws the bushing and sleeve tightly together. Thus the assembly is locked in the elongated hole *N* at any desired position along axis *X* - *X*, so that various locations can be obtained. Inasmuch as the work cannot be moved in a direction at right angles to axis *X* - *X*, alignment of the hole *W* with the locating hole is unaffected

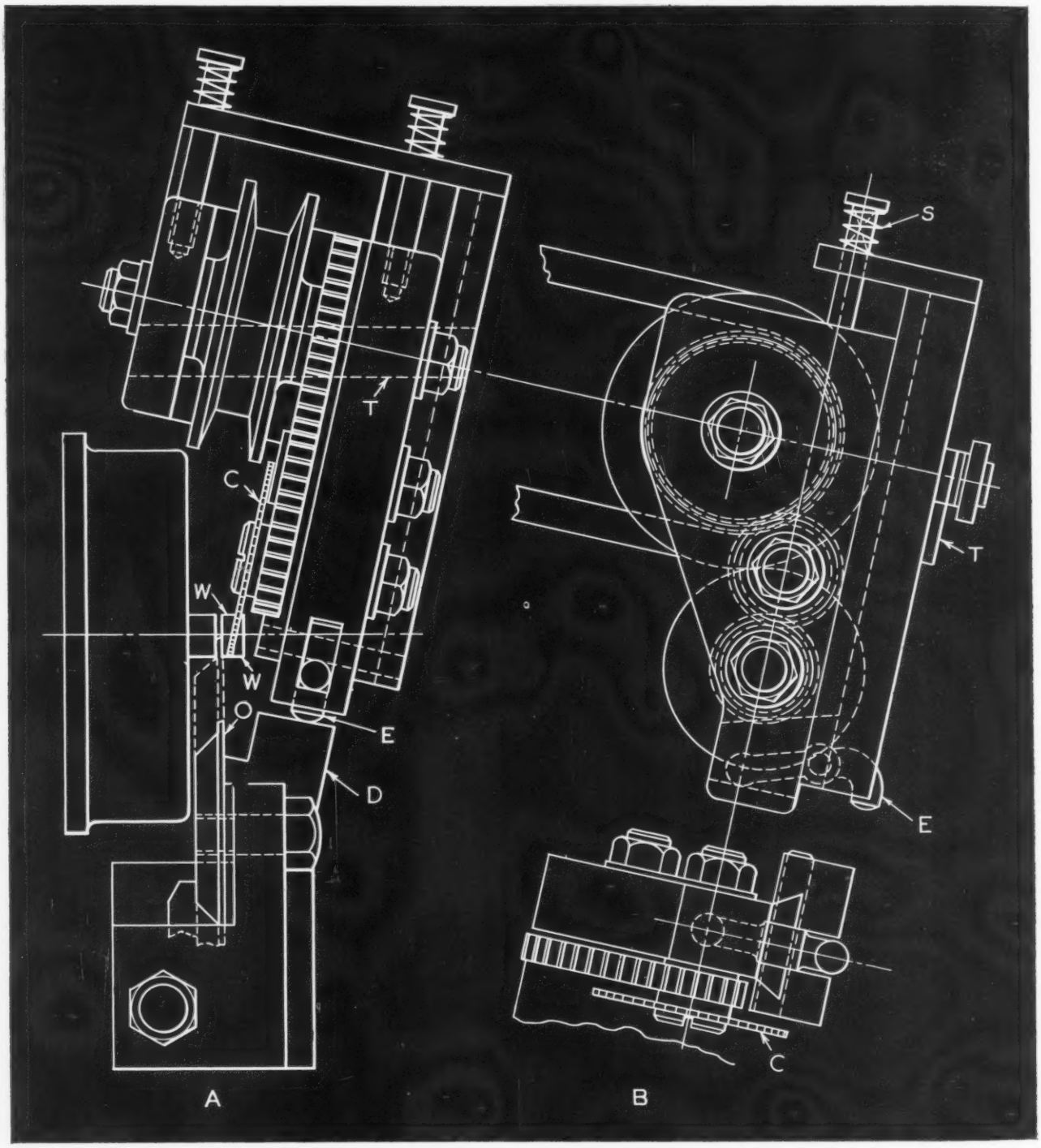


Fig. 1. Special Angular Cut-off or Sawing Attachment and Straight Cut-off Tool Used in Production of Wedge-shaped Washers W on a Brown & Sharpe Automatic

Sawing Attachment for Cutting off Wedge-Shaped Washers on B & S Automatic

By JOHN J. McNEFF, Manager
Victor Cam Co., Irving, Tex.

Large quantities of small wedge-shaped washers, such as shown at *W*, Fig. 1, are used in the construction of certain types of aircraft. The special cutting-off tool shown in the illustration has provided a successful means of producing these parts on a Brown & Sharpe automatic. View *A*, Fig. 1, shows the chuck used to hold the bar stock from which the washers are cut off. This view also shows the arrangement of the angular cutting-off attachment, fitted with a circular saw *C*, which is mounted on the rear slide of the machine. The regular circular type cutting-off tool *O* is mounted on the front slide with a special rising block *D* for operating the saw-slide fulcrum piece *E*. It will be noticed that the parts *W* are made in tandem; that is, two parts are produced at each complete revolution of the camshaft.

The front and side views of the sawing attachment at *B* show the arrangement of the saw *C*, the driving pulley for the saw, the fulcrum piece, and the spring *S* which withdraws the saw from the work before the cam permits the tool-slide to drop back or recede. It will be noticed that the tongue *T* for locating the attachment by means of the groove in the machine cross-slide is milled at an angle of 12 degrees, so that when the fixture is set up and bolted in place, the cutting-off saw *C* will be located at the desired angle of 12 degrees with the spindle or axis of the work. The No. 0 B & S automatic screw machine on which the sawing attachment is mounted is equipped with a driving-stand attachment and spindle brake.

In Fig. 2 is shown an outline of the cams used on the machine to attain the necessary movements of the tools and machine members in the production of the wedge-shaped washers. For the benefit of those not familiar with cams of this design, their construction and the sequence of operations they control will be described. A spindle speed of 2660 R.P.M. is selected for this job, which gives a surface speed on 7/16-inch diameter stock of 300 feet per minute. The time in seconds is based on the revolutions of the spindle; that is, if 2660 revolutions are made in sixty seconds, then approximately 45 revolutions will be made in one second.

Space or clearance also enters into the calculations, and is determined by the number of hundredths of a revolution on the cam surface required for one tool to clear another. Finally,

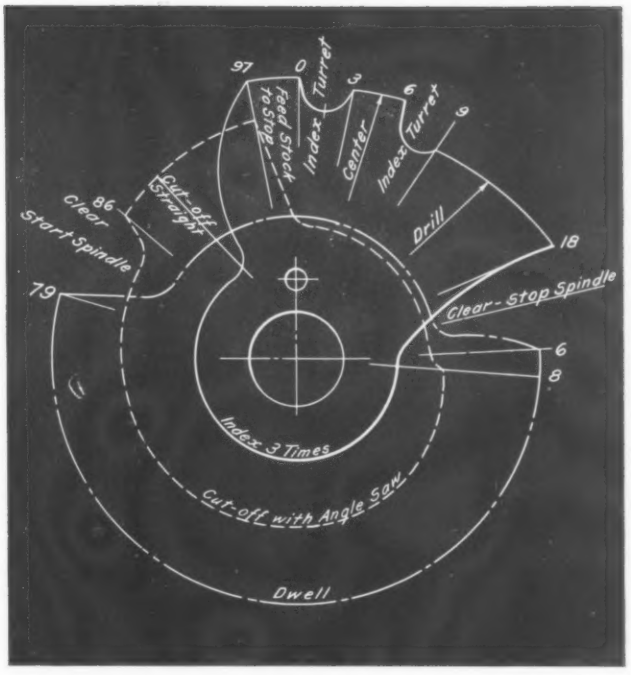


Fig. 2. Lay-out of Cam for Operating Special Angular Sawing and Cut-off Attachment Shown in Fig. 1

the feed per revolution at which the tool is fed into the work and the time for indexing tools into position are taken into consideration. With this information, as given in the accompanying table, the plotting of the cam is accomplished.

Operations in Cutting Off Wedge-Shaped Washers on B & S Automatic

Successive Order of Operations	Spindle Revolutions for Each Operation	Throw of Cam, Inches	Feed per Revolution, Inches	Hundredths of Cam Circumference	Total Hundredths of Cam Circumference
Index turret ...	26	.....	.....	3	...
Center	26	0.060	0.003	3	6
Index turret ...	26	.....	.....	3	9
Drill	80	0.390	0.005	9	18
Index turret—Clear and stop spindle	73	.....	.....	8	26
Cut off first piece with angular saw tool	471	0.450	0.001	53	79
Clear and start spindle	62	.....	.....	7	86
Cut off second piece by straight cut with circular cut-off tool *O*, Fig. 1	97	0.150	0.0015	11	97
Feed stock to stop	26	.....	.....	3	100

Spindle speed 2660 R.P.M.; total revolutions 887; time for two pieces 20 seconds; gross production per hour 360 pieces.

Progressive Die for Producing Two Parts of Similar Design

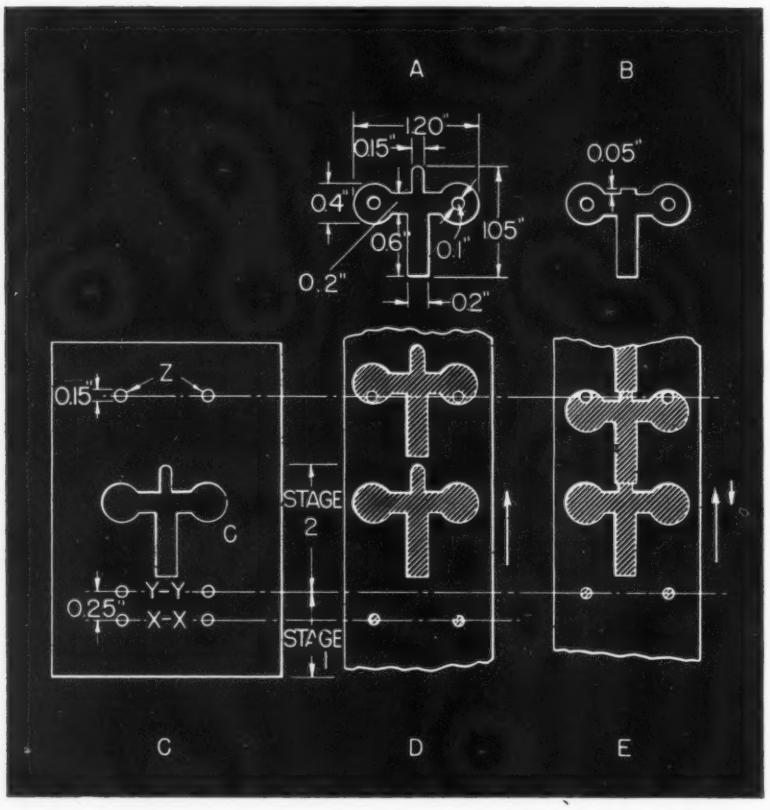
By FERDERICO STRASSER, Santiago, Chile

When two stampings are similar in design, varying only in minor detail, they can often be blanked out on the same die with a considerable saving in cost. Particularly can such means be adopted if the stampings are to be made in limited quantities, as in the case of the parts shown at *A* and *B* in the accompanying illustration. These parts are made from light brass strip stock. The only difference between them is in their overall length, the part *A* having a longer tip than *B*.

A standard two-stage, manually fed progressive die *C* was designed with two sets of piercing holes *XX* and *YY*. First the die set was arranged so that the piercing punches mated with holes *XX*, and the strip stock was fed through the die. In the first die stage small holes were pierced, and in the second stage the part was blanked. The stamping produced was like that shown at *A*.

In blanking out part *B*, the piercing punches were changed so as to mate with holes *YY*. The stock was fed through the die exactly as before, except that instead of positioning the blanked hole against the stop-pins as at *D*, the strip was pulled back so that the blanked hole was positioned on the opposite side of the stop-pins, as shown at *E*. In this way, the blanked hole in the strip was made to extend back into the second die stage and a shorter part *B* was punched.

Although the general arrangement of this die is such that a large amount of material is wasted, the material cost involved is only a fraction of the cost of a second die. This particular die effected a cost saving of nearly 50 per cent over that required for production of the two parts by conventional methods.



Two-Stage, Manually Fed Progressive Die Designed to Produce Both the Parts Shown at A and B. The Method of Punching Each is Shown at D and E, Respectively

* * *

Manhattan Rubber Division Completes Fifty-Fifth Year

The Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J., recently celebrated the completion of its fifty-fifth year. Manhattan traces its ancestry back to the first chartered rubber company in America—the Roxbury Rubber Co. of Boston, organized in 1833. In 1893, the Manhattan Rubber Mfg. Co. was founded in Passaic. Frank Cazenove Jones became the first president, but retired in 1903 in favor of Colonel Arthur Farragut Townsend, who served as president until 1929, when the company was merged into Raybestos-Manhattan, Inc. Today, the Manhattan Rubber Division is one of the largest manufacturers of mechanical rubber goods, and employs 4000 persons.

* * *

Quick Method of Fastening Pipe Hangers to Concrete or Metal

Only five seconds is required to fasten a pipe hanger to concrete or metal with a powder-actuated hand tool developed by the Mine Safety Appliances Co., Pittsburgh, Pa. Use of this five-pound portable tool eliminates the need for star drilling and inserting of toggle or anchor bolts. The tool firmly embeds studs in steel or masonry by the discharge of a blank cartridge. Embedded studs have a holding power of several thousand pounds. Two diameters of studs—3/8 and 1/4 inch—can be driven by changing the barrel on the tool.

Spacing Planetary Pinions

(*Continued from Page 188*)

grees, from No. 1. Then X will equal $\frac{144}{3.56436} = 40.4$. Using $X = 40$, $A = 40 \times 3.56436 = 142.57440$ degrees = 142 degrees 34 minutes 28 seconds. Similarly, No. 4 pinion should be located at an angle of three times 72 degrees, or 216 degrees, from No. 1. In this case, $X = 61$, and $A = 61 \times 3.56436 = 217.42596$ degrees = 217 degrees 25 minutes 33 seconds. Also, No. 5 pinion should be placed 288 degrees from No. 1. Here $X = 81$ and $A = 288.71316$ degrees = 288 degrees 42 minutes 47 seconds.

When the number of teeth on the various gears in a planetary set are such that even spacing of the planetary pinions is possible, the calculation for X will result in a whole number and angle A will give the desired spacing between all of the planet pinions. Such a case would result from the use of seven pinions, where $N_s = 70$, $N_i = 112$, and $n = 21$. Then $\frac{360}{N_s + N_i} = \frac{360}{70 + 112} = 1.978022$, and the desired ideal spacing is $\frac{360}{7} = 51.42857$ degrees.

$$\text{Then } X = \frac{51.42857}{1.978022} = 26, \text{ and}$$

$A = 26 \times 1.978022 = 51.42857$ deg. = 51 deg. 25 min. 43 sec.

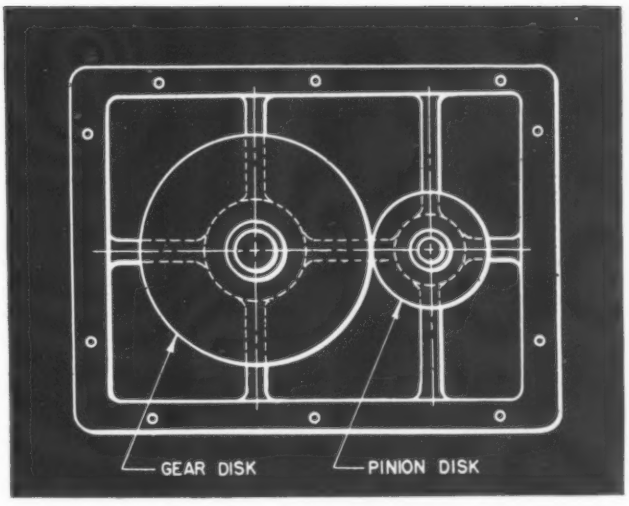
* * *

Simplified Method of Selective Assembly for Gear Drive

By ROBERT MAWSON

In assembling a certain type of machine tool, a manufacturer encountered considerable trouble with a gear-reduction drive. In certain cases it was practically impossible to rotate the gears due to interference of their teeth. With other assemblies there was excessive noise due to backlash.

The larger gear of the drive had a pitch diameter of 12 inches, and its pinion, a pitch diameter of 6 inches. Both gear and pinion were mounted on shafts that revolved in bearings located in the housing and housing cover of the machine tool. The housing and cover castings, gears, and pinions had been carefully machined to maintain maximum accuracy. The resulting performance proved that there was a variation in the center-to-center distance between the gears, caused either by a difference in the composition of the castings or expansion of the castings as a result of boring their bearing seats. Whatever the cause, it became necessary to eliminate the resultant delays in assembly, running in of the gears when they fitted too tightly, and the noise caused by excessive backlash.



By Trying Various Sizes of Pinion Disks and a Master Gear Disk, the Correct Pinion Size to be Used at Assembly can Easily be Determined

The problem was solved by measuring the center-to-center distance between bearings in a number of machined gear housings. From these dimensions, a suitable tolerance was established. Then, to fit this tolerance, three sizes of pinions were manufactured. One group of pinions was made to nominal dimensions, another over size, and a third lot under size. These pinions were placed in stock, suitably marked.

For inspection purposes, four hardened and ground, tool-steel disks were made and placed on shafts of the proper size. The diameter of one disk was made equal to the nominal pitch diameter of the large gear, another to the pitch diameter of the pinion, a third to the pitch diameter of the pinion plus the allowable tolerance, and the last under size.

During inspection of the finish-machined housings and covers, the large gear disk shaft was mounted in the housing and the various pinion disk shafts were tried, as indicated in the accompanying illustration. The most suitable drive was determined by rotating the pair of gear disks and measuring the clearance between their peripheries by means of feeler gages. The cover was then placed on the housing as a final check. When a satisfactory drive was obtained, the cover and disk shafts were removed and the housing was marked to identify the particular size of pinion to be used in assembly.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER Sales Engineering Consultant

The Successful Sales Engineer Follows Through

SINCE the machinery sales engineer sells a capital investment—not an item of expense—he seldom wins an order with only one call on the prospect. Repeated contacts are necessary.

From the first move toward obtaining an order, the sales engineer is investing his time. The initial investment is lost without added investments in time, thought, and effort. Getting an order is not like making a machine. It is like running a race. Unless the final one-tenth of one per cent of effort is expended, no race is won, no order obtained. Only experience, and perhaps customer good will and future obligation, remain to sweeten the loss.

The importance of following up a negotiation is only equalled by the way in which it is done—the way in which each successful move is made. Planning these successful moves is vital to every sales engineer, because each call should uncover new and changed customer interests and reactions. Each call on a prospect must be both "pre-planned" and "re-analyzed."

From each call we probably learn a lot. We get a new set of facts and perhaps discover opinions held by the prospect that either have to be strengthened or altered. What turn has the job taken? What new resources can be employed? What new strategy can be used? What serviceable device can be engaged to meet objections and influence opinion? How about the timing of the next move? These few questions and a lot of others strike the mind of the sales engineer as he leaves the prospect's plant. Any one of us can recall the glow of satisfaction we experienced from successfully performing our first selling move. But most of us can also recall our subsequent disappointment due to our inability to follow through.

This is what one successful sales engineer does in following up each inquiry:

1. He never leaves a prospect without some understanding of what his next move should be. It may be an exact evaluation of savings to be made; the furnishing of a blueprint showing further details of his machine; or the making of an appointment with others involved to discuss a proposal.

2. When he cannot get a favorable decision, he tries to create a reason for preventing a decision against him. He gets a commitment that no decision will be made until additional important facts are presented.

3. Immediately following the interview, he makes a plan for further procedure. He thinks of a new angle of approach, new sales arguments, a new way of attacking customer's objections. He conjures up additional selling points by tapping other resources. He outlines a road map for future moves.

4. When a negotiation lags and he decides to call up the prospect, his approach is not like this: "I just called up to find out how the job is coming along." Such a remark has only the advantage of indicating interest. His follow-up is a remark like this: "On your lapping problem and my quotation on our 'Continental' machine, I have a very interesting new example of savings to be made . . ." This is, of course, a specific approach. Some new idea is introduced. At the same time, he invites an answer to the question of how the job stands.

5. He always sends some suitable, well timed, follow-up letter or piece of literature that may help to influence the purchaser. Even a clipping from a magazine pertinent to the case may show interest and carry a favorable impression.

6. He thinks of his friends who have had contact with his customer and of some valuable evidence which they could furnish to help shape and time his case with a view to favorably influencing the prospect.

Aesop's fable of the tortoise and the hare was written over twenty-three centuries ago, but it is as true today as it was then. The tortoise had a plan. This plan was to keep going, and in the right direction.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Blanchard Automatic Surface Grinder

An automatic surface grinder, known as the No. 22-A3, has been added to the line built by the Blanchard Machine Co., 64 State St., Cambridge 39, Mass. This grinder has three wheels, 22 by 4 by 16 inches, and a work-table having an outside diameter of 68 inches and an inside diameter of 40 inches. Work up to 12 inches in height and of any size that can be accommodated between the inner and outer edges of the table can be ground. The columns can be extended to take work of a greater height when required.

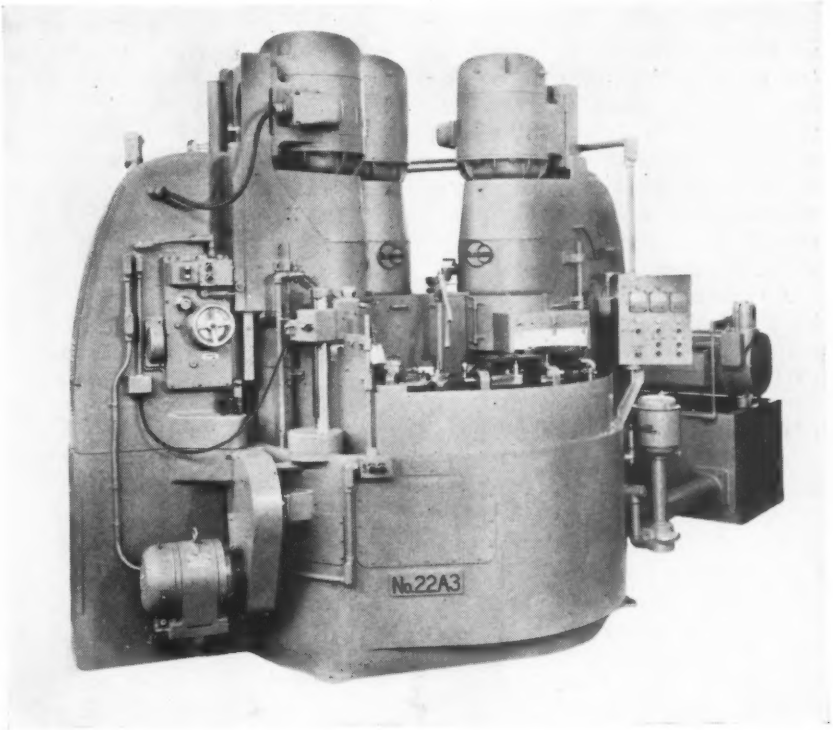
With two wheels employed for roughing and one for finishing, the machine will remove any amount of stock ordinarily allowed on castings within its capacity. The machine can also be operated with one wheel roughing and two wheels finishing, or if a relatively rough finish is satisfactory, all three wheels can be employed to take heavy cuts.

Each wheel is followed by a wheel control caliper which maintains the wheel face at a fixed height above the work-table. The continuously rotating table carries the work in succession under the roughing and finishing wheels, each wheel reducing the work height to that determined by the setting of the caliper for that wheel. The final size is held to within $\pm$ 0.0005 inch.

The coolant system provides for continuously removing chips and sludge from the coolant and depositing them in a sludge tank which can be readily removed for emptying, no sludge being allowed to remain in the base tank. A motor-driven centrifugal pump of 150 gallons per minute capacity delivers water to the wheels and to nozzles for washing the work and fixtures. A second similar pump supplies agitator nozzles in the base and delivers coolant from the base to a Barnes magnetic separator, which is mounted over a separate outside tank. This tank and the base tank are connected by a large straight pipe. The coolant in the base is continuously agitated, keeping the sludge in suspension so that it can be pumped to the separator.

From the separator the clean coolant drops into the outside tank and flows back to the base tank. The cleaning of the sludge out of the coolant in the base goes on continuously while the machine is in operation, and by means of a timing device which delays the stopping of the second pump and the separator motor, this cleaning action is continued for several minutes after the rest of the machine is shut down. Most of the sludge in suspension is removed in this way, and the little that settles in the main tank after the machine has been stopped is readily stirred up when the machine is next started.

Another novel feature is the electrically operated wheel dressers. Built into each wheel-head is a solenoid-operated dresser. On the control panel at the operator's position is an ammeter for each wheel motor, and directly below each ammeter is a button for operating the wheel dresser. Momentary pressure on the button causes the dresser cutters to be briefly forced against the wheel face, breaking loose the dull grains but not removing enough from the wheel to require any adjustment to maintain size. The dressers automatically follow up the wheels as they wear and are always in position to dress the wheel whenever the button is



Automatic Surface Grinder Equipped with Three Grinding Wheels, Brought out by the Blanchard Machine Co.

To obtain additional information on equipment described on this page, see lower part of page 228.

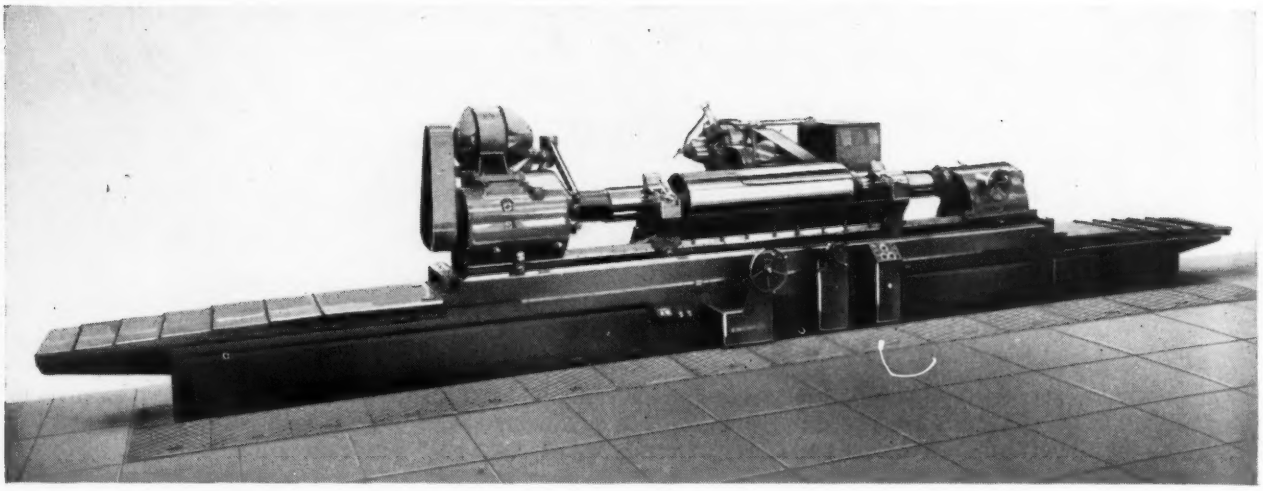


Fig. 1. Cincinnati "Filmatic" 28- by 168-inch Heavy-duty Roll-grinding Machine Equipped with Swivel Table and Solid Footstock

pressed. For convenience in renewing dresser cutters, the cutters and the pin on which they revolve are carried in a removable holder which is secured by one wing-nut to the dresser.

Each wheel-head has a short, heavy spindle mounted in preloaded ball bearings and coupled to a 30-H.P. totally enclosed fan-cooled induction motor. Larger motors can be supplied if required. A 3-H.P. motor drives the rotary table; smaller motors provide power for rapid raising and lowering of the wheel-head, and for the feed, coolant pump, and separator. The control apparatus for all thirteen motors is housed in one cabinet which stands on the floor near the machine. The control current is 110 volts, and a separate transformer provides 110-volt current for operating the motors that are employed to drive the wheel dressers.

An emergency stop button, which stops all motors except the No. 2 pump and separator motors, is provided on the control panel, and a similar stop button is mounted on the base of the machine. Jog buttons for moving the rotary table are provided at several points to facilitate setting up. The machine, without fixtures or coolant, weighs approximately 41,000 pounds. The coolant capacity is 475 gallons. 61

Cincinnati "Filmatic" Heavy-Duty Roll-Grinding Machines

The recently expanded line of large "Filmatic" grinding machines built by Cincinnati Grinders Incorporated, Cincinnati, Ohio, includes new 20-, 24-, and 28-inch swing heavy-duty, traveling-table roll-grinders. Each of these machines is available in five between-center lengths of 8, 10, 12, 14, and 16 feet. Longer machines, however, can be built to order. Outstanding new features incorporated in these machines include electronic table traverse, which provides an infinite number of speeds and improves accuracy of reversal; and automatic wheel balancing.

As in other Cincinnati grinding machines, the grinding-wheel spindles of these machines run on Filmatic bearings, which require no adjustment and are lubricated with pump-circulated filtered oil. A pressure switch closes the electrical circuit to the grinding-wheel motor after the oil pressure in the bearing compartment builds up to a few pounds, and cuts out this motor if the oil pressure fails.

The grinding-wheel spindle is equipped for automatic balancing, the complete spindle and "Filmatic" bearing assembly being mounted in a unit which can be rigidly clamped to the wheel-head for the grinding operation or unclamped and supported on cantilever springs for the balancing operation. A raceway in the end of the spindle that is concentric with the axis of the journals houses three hardened steel balls. A spring-loaded, hydraulically released plunger is provided for clamping and unclamping the balls. When the plunger is released, the balls are free to change their positions in response to the forces that act when the bearing system is unclamped and elastically supported for balancing. A two-position lever clamps and unclamps the entire unit. With this equipment, perfect balance is quickly established...62

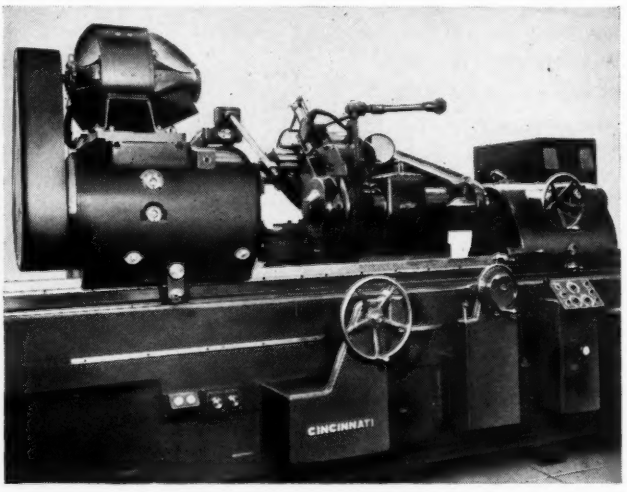
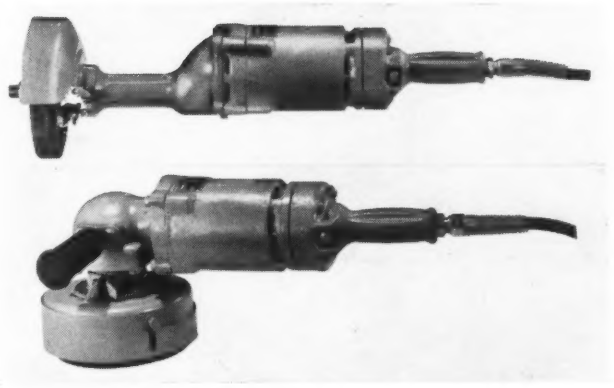
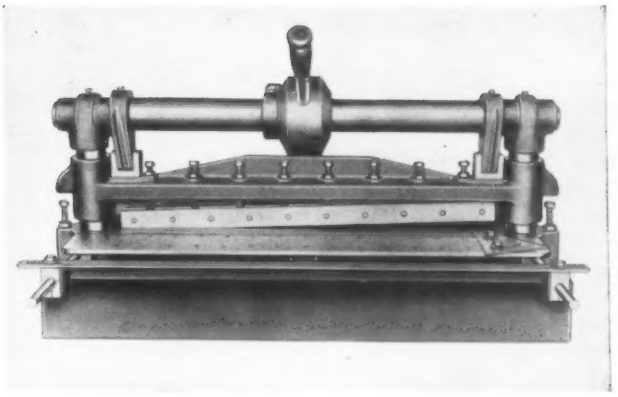


Fig. 2. Close-up View of Operating Controls of Cincinnati Roll-grinding Machine Shown in Fig. 1

To obtain additional information on equipment described on this page, see lower part of page 228.



Two Grinders in 360-cycle Portable Tool Line Made by Rotor Tool Co.



Di-Acro Precision Shear Brought out by the O'Neil-Irwin Mfg. Co.

The electronic control for the table traverse provides an infinite range of traverse rates from 3 to 120 inches per minute. Other electrical controls accelerate and decelerate the table at reversal.

Electrical push-buttons and rheostats at the operating station control starting and stopping, table traverse, table tarry, headstock spindle speed, coolant flow, dynamic braking for the headstock motor, and pick-feed. Included in the electrical equipment is an automatic wheel-speed compensator which is built into the truing unit. As the truing sleeve is adjusted toward or away from the wheel, the speed automatically increases or decreases.

Camber or crown on the rolls is obtained through a tilting wheelhead cambering unit. This unit is connected to the table-traverse rack by a gear train with hydraulic motor, which automatically removes the backlash. An adjustable double eccentric, in combination with change-gears, provides an infinite selection of cambers within the range ordinarily required on mill rolls.

The wheel-truing unit is actuated by hydraulic power, and is arranged for cam-controlled profile truing, cams being selected to suit the camber being ground. The table and wheel-head ways are automatically pressure-lubricated by a filtered-oil system which includes pressure switch protection, pressure gages, and regulators. Headstock parts are automatically lubricated by a built-in pump.

Ordinarily, these machines are equipped with set-over footstock and solid table. However, they can be provided with solid footstock and swivel table, gap tables, and other units if required.....62

Rotor 360-Cycle Portable Electric Tools

The Rotor Tool Co., Cleveland, Ohio, has brought out a line of 360-cycle portable abrasive tools, including small wheel grinders; cone sanders; 4-, 6-, and 8-inch straight grinders; 6-inch cup grinders; 7- and 9-inch sanders; and 9-inch polishers.

The motor spindle speed (21,600 R.P.M.) is governed by the 360-cycle frequency supplied by an inductor frequency converter or motor-generator. For heavy operation, the motor speed is geared down to the correct spindle speed.

There are no electrical connections between the stator and the rotor, and the speed under severe loading is maintained within 5 per cent of the free speed. Ample cooling is provided. It is claimed that the power cost of operating these 360-cycle tools is low. The 360-cycle tools offer all the advantages of conventional 180-cycle tools, with corresponding weights reduced about one-third. 63

"Kennamatic" Style 12TK and 12SK Tools with Solid Kennametal Inserts

Di-Acro Hand-Operated Shear

A new No. 4 Di-Acro shear designed for the rapid shearing of a wide variety of materials, both non-metallic and metallic, to extremely close tolerances is a new product of the O'Neil-Irwin Mfg. Co., 332 Eighth Ave., Lake City, Minn. The maximum shear width is 24 inches, and maximum material capacity is 16-gage sheet steel. Proportionately heavier gages of more ductile materials can also be handled. A protractor gage is furnished for squaring and mitering, which can be quickly adjusted for any degree of angularity desired. Another gage permits cutting strips of less than 0.025 inch in width. Adjustable stops provide for accurate control of shearing, slitting, and notching operations. The shear blades are of alloy steel, and all four blade surfaces have a hardened and precision-ground edge. 64

Kennametal Tools

Kennametal Inc., Latrobe, Pa., has developed a line of "Kennamatic" tools having "indexable" and replaceable solid Kennametal inserts of square or triangular shape, which are mechanically held in a vertical position. Two typical styles, designated 12SK and 12TK, are shown in the illustration. Six different styles of tools having triangular inserts are available with Kennametal cemented-carbide K2S, K3H, and K6 inserts, which are selected to suit the type of metal to be machined.

Inserts are available in sizes from 3/4 inch square to 1 inch

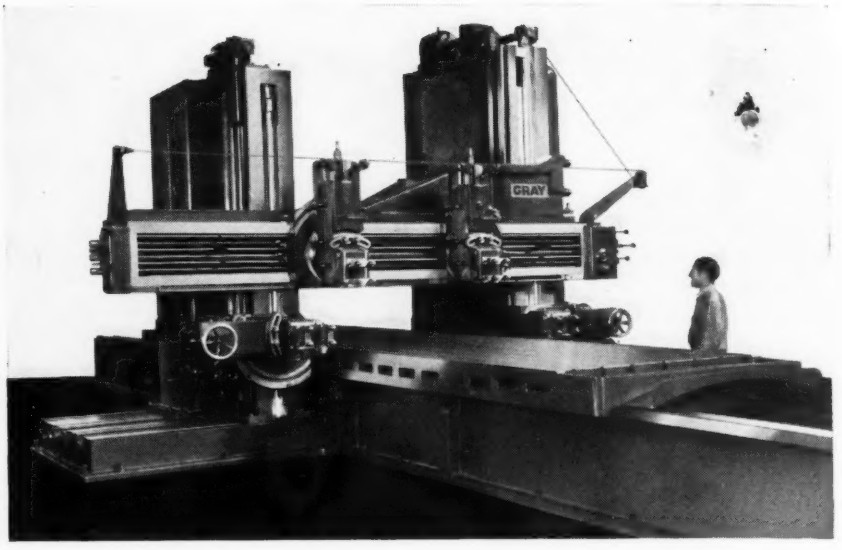
To obtain additional information on equipment described on this page, see lower part of page 228.

by 1 1/2 inches, and are suitable for such machining operations as turning to a square shoulder, multiple turning on a small-diameter shaft, turning thin-wall tubing, plunge-turning, cam machining on an automatic lathe, facing perpendicular to work axis, turning with tool shank parallel to work axis, straddle-facing, and similar operations. The inserts can be indexed six to eight times before regrinding. 65

Gray Adjustable Open-Side Planer

Versatility is a feature of the new adjustable-convertible open-side planer introduced by the G. A. Gray Co., 3606 Woodburn Ave., Cincinnati, Ohio. Manual or power in-and-out adjustment of the outboard housing provides flexibility of the left-hand sidehead. Wide jobs can be accommodated by the removal of the outboard housing, which is mounted on a wide runway secured to the main bed.

Rigidity is secured through clamping the rail to the housing, as well as the knee to the main column. Both of the power-operated clamps are automatic and synchronized. The left-hand sidehead is actuated by a self-contained rapid-traverse system, and its feed and automatic tool-lifter mechanisms are connected with the main system. The planer can be equipped with non-metallic table ways and a "Space-Saver" drive. Table speeds up to 300 feet per minute are provided. 66



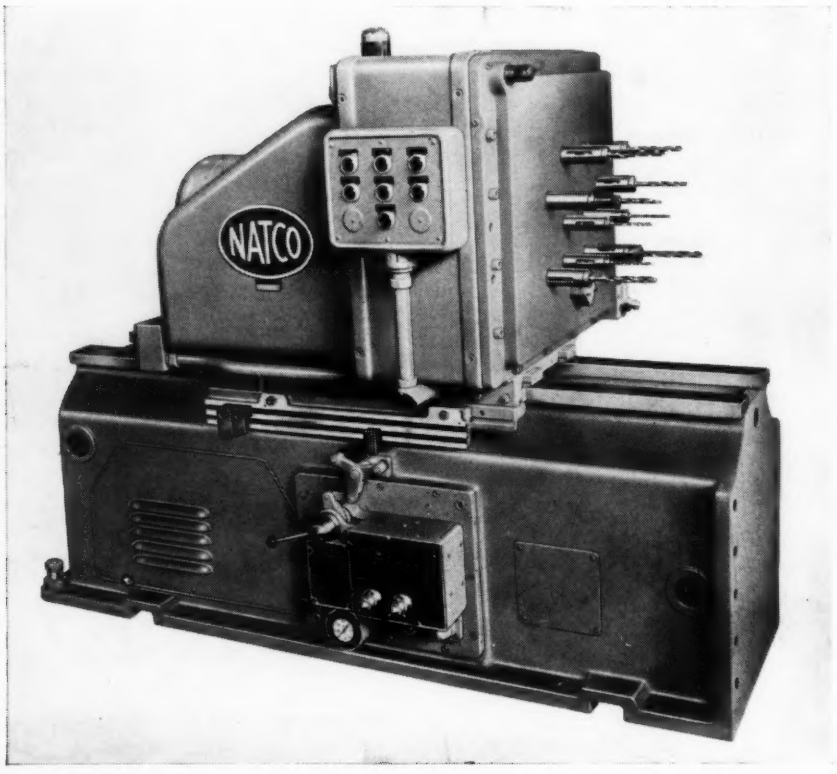
Adjustable and Convertible Open-side Planer Built by G. A. Gray Co.

Natco Floor Type Units for Constructing Way Type Machines

The National Automatic Tool Co., Inc., Richmond, Ind., has announced three new Holesteel Model C floor type production machine tool units designed to be used in constructing way type machines for drilling, boring, tapping, and similar operations. These units, designated Models C2FT, C3FT, and C4FT, are arranged with standard single-spindle heads, fixed-center multiple-spindle heads, or adjustable multiple-spindle heads, together with other standard spindles or slip spindle plates and spindles to suit specific applications.

The electrically controlled hydraulic feed systems of the units provide an infinitely variable feed selection within a specified range. Electrical push-button control facilitates setting up. The cabinet sections of the units enclose the hydraulic pressure pumps and all the hydraulic system piping. The hydraulic feed control panel is mounted on the left side of the cabinet section while an inspection cover and a protected oil filler opening is located on the right side. The single-spindle head is direct motor-driven and mounted in anti-friction bearings. Lever-operated sliding gears allow a selection of seven spindle speeds within a given range through splined pick-off gears.

Adjustable-spindle heads are also of anti-friction mounted con-



Natco Floor Type Unit Designed for Use in Constructing Way Type Machines

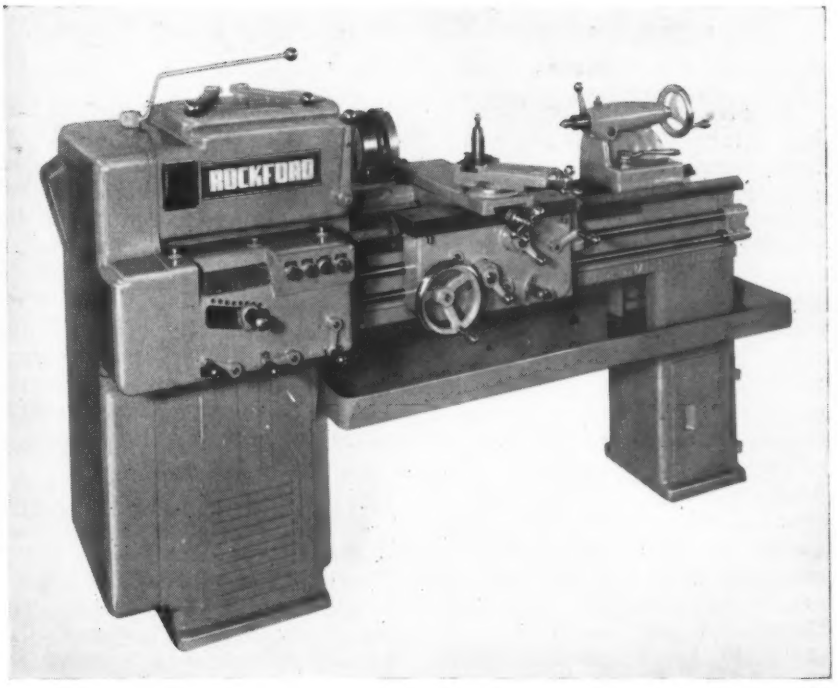
To obtain additional information on equipment described on this page, see lower part of page 228.

struction. Each spindle drive has independent spindle speed changes, which provide high-speed, low-speed, and neutral positions. The adjustable spindles can be located in any position within the area of the head. A vertical adjustment of 2 inches is provided to compensate for differences in tool length.

Fixed-center multiple-spindle heads are designed to suit individual requirements. Combination drilling and tapping heads are provided with independent reversing type motor for the tapping spindles. The control panel includes directional control, feed rate control, pressure gage, pump relief valve for pressure control, and solenoids for electrical remote control. 67

Rockford Medium-Size "Economy" Lathe

The Rockford Machine Tool Co., Rockford, Ill., is now building a medium-size, general-purpose lathe of improved design which will supersede the Rockford lathe that was discontinued during the war. The all-geared headstock of the improved lathe has twelve spindle speeds, any of which can be instantly obtained by operating a lever. The spindle is mounted on Timken precision bearings, and is machined from a high-alloy steel forging. The spindle nose has a No. 1 tapered key drive. The heat-treated gears are precision-finished to insure exceptionally smooth operation. Positive gear lubrication is assured by an immersion and oil-splash system. Spindle speeds are available that are suitable for cutting with tungsten-carbide tools. 68



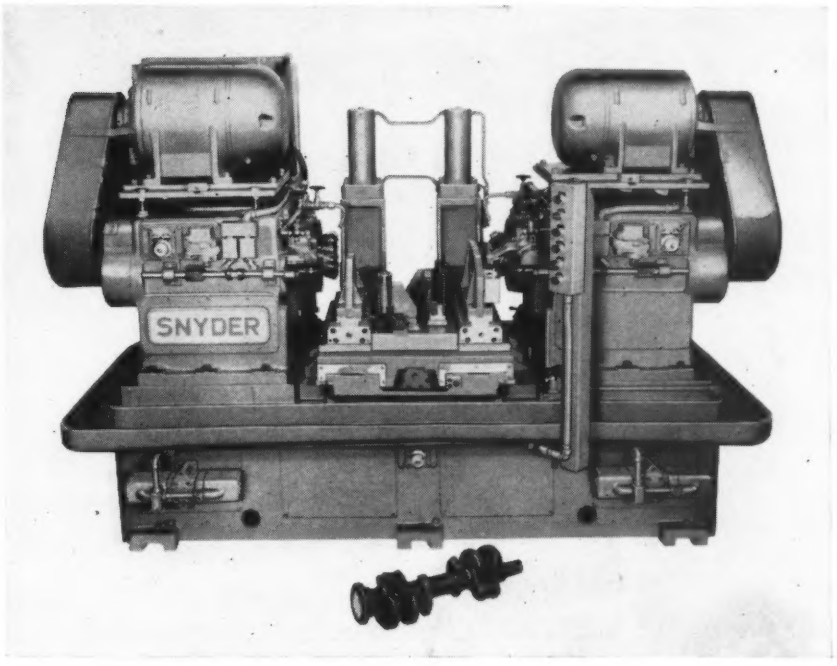
Rockford "Economy" Lathe of Improved Design

Snyder Special-Purpose Crankshaft Facing and Center Drilling Machine

The Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit 7, Mich., has designed a special-purpose machine that will face and center-drill the ends of crankshaft forgings at the rate of forty-seven pieces an hour. The crankshaft forging is located manually in the fixture and held by hydraulically actuated clamps. Pressing the cycle button causes the fixture table to advance rapidly toward the milling cutters and slow down to the feeding rate while both ends of the forging are faced to the correct length.

The fixture table then returns and hydraulically actuated quills carrying the centering tool spindles advance and drill centers in both ends of the forging. The milling spindles are mounted in Timken bearings, and inserted-tooth milling cutters are used at a speed of 350 feet per minute.

This machine is adaptable to a wide range of work lengths, and has adjustable speeds and feeds. The stroke can be adjusted within the range of 8 to 12 inches. Power is supplied by a 15-H.P. motor through belting and helical gears. The machine requires a floor space of 108 by 70 inches. 69



Snyder Machine for Facing and Center Drilling Ends of Crankshaft Forgings

To obtain additional information on equipment described on this page, see lower part of page 228.

Michigan Universal Checking Fixture for Gears, Hobs, Worms, and Cutters

A universal "Sine-Line" checking fixture for inspecting gears, hobs, worms, milling cutters, and form tools up to 10 inches in diameter by 8 inches wide has been placed on the market by the Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich. With two standard indicator assemblies, a single fixture can be used to check tooth spacing, pitch radius, concentricity, and taper of spur and helical gears. A special feature of the machine is the use of Carboloy-tipped cones for checking spur and helical gears. These cones assure the maintenance of accuracy even when they are used for production checking. An additional indicator assembly will check the parallelism and crowning of spur gears. Two special indicator assemblies are available to check the thread spacing and pressure angle of worms.

The universal fixture may also be used on form and milling cutters to check flute spacing, radial or off-center sharpening, depth of form, parallelism of straight flute, peripheral eccentricity, and the amount of form relief; and on hobs to check flute spacing, radial or off-center sharpening, parallelism of straight flute, lengthwise taper, concentricity of proof diameters, multiple-thread spacing or axial lead, and pressure angle. The tooth depth and concentricity of topping hobs can also be tested. All indicator assemblies can be used with the Michigan automatic checking recorder when a permanent record of the gear, worm, milling cutter, or hob inspected is desirable.

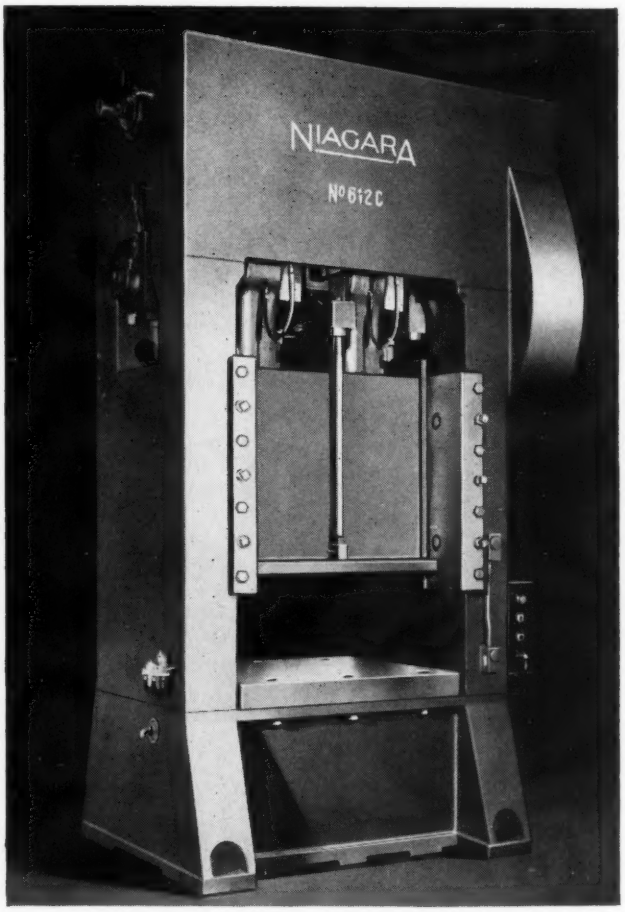
The lower sub-assembly of the indicator base travels lengthwise on anti-friction bearings, with safety stops provided to limit the travel. The indicator is moved in or out by a rack and pinion. The headstock and tailstock may be clamped at any point on their ways, and the tailstock center is retractable. 70

Niagara Single- and Double-Crank Straight-Side Presses

The Niagara Machine & Tool Works, 637 Northland Ave., Buffalo 11, N. Y., has recently completed several newly designed, all-welded straight-side presses of both the single- and double-crank style. Typical of this new line is the double-crank, single-geared, tie-rod frame press shown in the illustration, which has a rated capacity near the bottom of the stroke of 185 tons. The high-speed shaft and flywheel are mounted within the crown above the crankshaft. An air counterbalance is provided for the slide.

Bearings are provided on each side of the back-shaft pinion to prevent shaft deflection. The deep bed, slide, and crown also minimize deflection, and the welded construction permits flexibility in

Universal "Sine-Line" Checking Fixture being Used to Inspect Parallelism and Crowning of Spur-gear Teeth



Double-crank, Single-geared Press of 185 Tons Capacity Brought out by Niagara Machine & Tool Works

To obtain additional information on equipment described on this page, see lower part of page 228.

dimensions. Use of a five-way clutch control is optional on any of these machines, which are equipped with an electro-pneumatic friction clutch. 71

Special Drilling Machine

A special-purpose machine designed for drilling holes in small parts by feeding the drills up from the under side of the work, to facilitate clearing out chips and to increase production, has been brought out by Zagar Tool, Inc., 23880 Lakeland Boulevard, Cleveland 23, Ohio. This machine is composed of a standard Zagar gearless drill head and two hydraulic cylinders which act as the feed mechanism for the head. There is a fast approach to the drilling position, a feeding rate during drilling, and a fast return to the original position. The drills are rotated by a direct-drive electric motor.

The work-holding fixture comprises an indexing mechanism in which the parts are loaded and indexed under a hard steel plate, the loading being done while the drilling operation is taking place. The cycle is controlled by electrical limit switches and solenoid-operated hydraulic valves. A hydraulic pump and an electric driving motor, together with a cooling chamber, are contained in the welded steel base. 72

Deep-Throat Press

A 15-ton Rousselle deep-throat press has been added to the regular line of open-back, inclinable, and adjustable-bed horn type punch presses manufactured by the Service Machine Co., 7627-33 S. Ashland Ave., Chicago 20, Ill. This press has an 18-inch throat which permits working to the center of 36-inch sheets; a bolster plate 11 by 16 inches; a shut die height of 7 3/4 inches; a 2-inch stroke; and a 6-inch opening in the bed to allow blanks and slugs to fall through. It is equipped with a single-stroke or continuous type clutch, a roller-bearing flywheel, a large air-cooled brake, and a hinged motor mount. The operating speed is 200 R.P.M. with a 1-H.P. 1750-R.P.M. motor. The weight of the press is 1875 pounds. 73

Gage for Gear Teeth

A new stainless-steel gage for quick checking of gears, designed to eliminate the tedious calculations often required to determine the unknown pitch of a gear, has just been added to the line of gear-testing equipment and precision tools manufactured and distributed by the George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y. This gage is similar to the one described in February MACHINERY, for gaging teeth having a pressure angle of 14 1/2 degrees. The new gage has been developed for gaging teeth with a 20-degree pressure angle of either full-length or stub-tooth form. 74

Special Small-parts Drilling Machine Brought out by Zagar Tool, Inc.

Rousselle Deep-throat Press Brought out by the Service Machine Co.

To obtain additional information on equipment described on this page, see lower part of page 228.

Sibley Improved Drilling Machines

An improved drilling machine known as Model D is being offered in 24- and 28-inch swing sizes by the Sibley Machine & Foundry Corporation, South Bend, Ind. A new feature developed to increase operator efficiency is a V-belt drive direct from the motor to a four-speed geared transmission which is part of the top frame assembly. Changing speeds is facilitated by an "inching" button on a four-station switch on the machine and the handy position of the four-speed transmission control lever. Three optional ranges of spindle speeds are available: 21 to 365 R.P.M.; 25 to 419 R.P.M.; and 37 to 650 R.P.M.

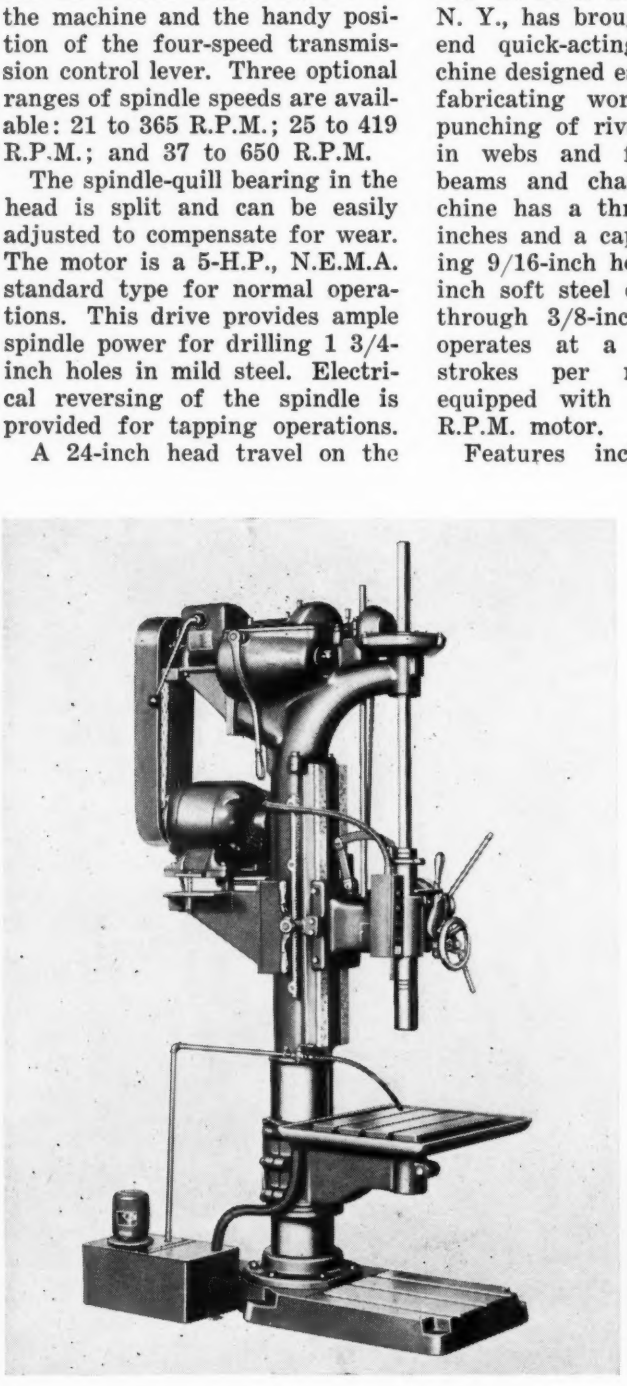
The spindle-quill bearing in the head is split and can be easily adjusted to compensate for wear. The motor is a 5-H.P., N.E.M.A. standard type for normal operations. This drive provides ample spindle power for drilling 1 3/4-inch holes in mild steel. Electrical reversing of the spindle is provided for tapping operations.

A 24-inch head travel on the column and a 11-inch spindle feed permit a wide range of drilling. The table arm and table rotate on the column, making the base easily accessible for a working surface. The head is adjusted by a rack and pinion elevating device. The feed mechanism is driven directly from the main drive-shaft through a steel feed-worm and bronze worm-gear. Four feed changes are obtained by a sliding shaft in the center of the handwheel. An adjustable stop-collar on the graduated quill trips the feed at any desired depth. 76

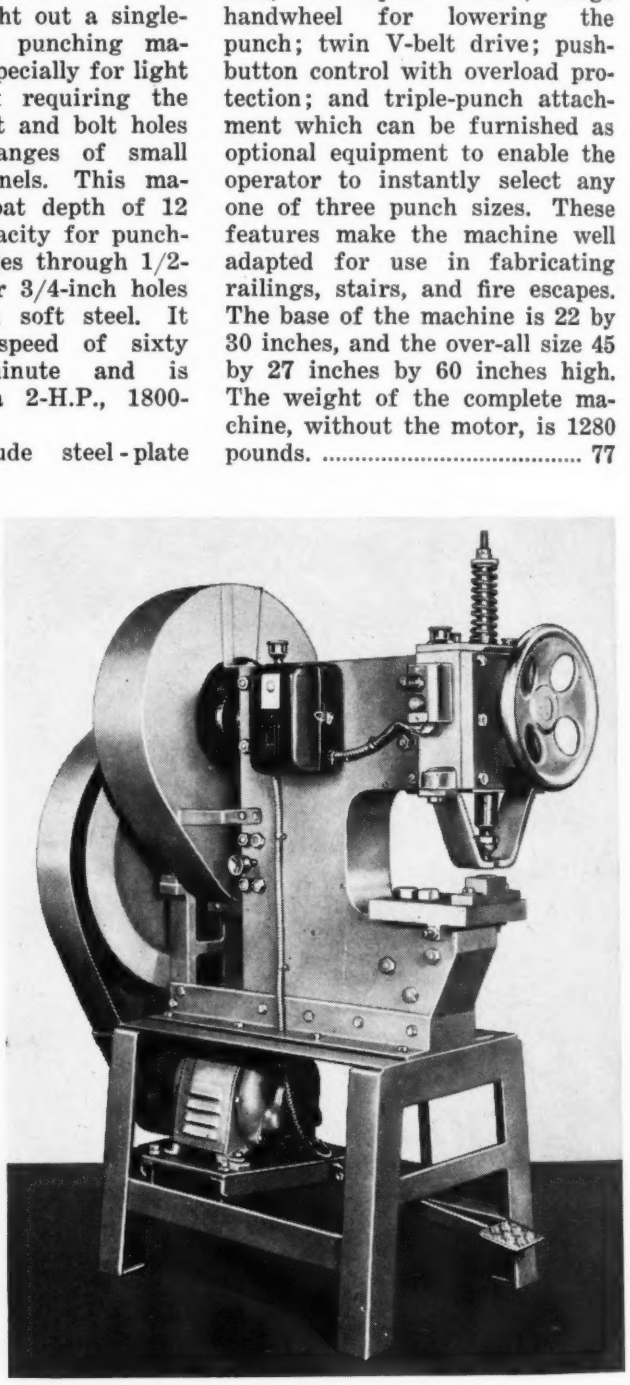
Blum Single-End Punching Machine Developed for Light Fabricating Work

Julius Blum & Co., Inc., 532-540 W. 22nd St., New York 11, N. Y., has brought out a single-end quick-acting punching machine designed especially for light fabricating work requiring the punching of rivet and bolt holes in webs and flanges of small beams and channels. This machine has a throat depth of 12 inches and a capacity for punching 9/16-inch holes through 1/2-inch soft steel or 3/4-inch holes through 3/8-inch soft steel. It operates at a speed of sixty strokes per minute and is equipped with a 2-H.P., 1800-R.P.M. motor.

Features include steel-plate frame construction; a foot-operated, non-repeat clutch; large handwheel for lowering the punch; twin V-belt drive; push-button control with overload protection; and triple-punch attachment which can be furnished as optional equipment to enable the operator to instantly select any one of three punch sizes. These features make the machine well adapted for use in fabricating railings, stairs, and fire escapes. The base of the machine is 22 by 30 inches, and the over-all size 45 by 27 inches by 60 inches high. The weight of the complete machine, without the motor, is 1280 pounds. 77



Improved Drilling Machine Brought out by Sibley Machine & Foundry Corporation



Single-end Punching Machine Placed on the Market by Julius Blum & Co., Inc.

To obtain additional information on equipment described on this page, see lower part of page 228.

Portable Welding Head with Magazine Feed for Cut Electrodes

Elge Associates, 16 E. 71st St., New York 21, N. Y., has brought out a portable arc-welding head designed to produce continuous welds, using standard coated cut electrodes. With this equipment, the cut electrodes are automatically fed from a magazine into the welding position. The magazine can be refilled with electrodes without interrupting the arc-welding operation, thus making possible continuous welds. Electrode magazines designed to permit overhead welding will also be available.

The welding head is ruggedly built of aluminum, steel, and heat-resistant alloys, and can be easily moved and set up by one man. Two of these heads, operated by one man, can be used for most production welding jobs. The head is equipped with all necessary controls for fine adjustment of the welding current and regulation of arc length, as well as vertical and horizontal adjustment. The carriage speed can be quickly adjusted within the range of 1 to 40 inches per minute.

Sheet and plate materials can be welded, and right-angle or oblique sections can be readily joined. Longitudinal welds on curved surfaces such as pipes and tanks can also be easily made...78

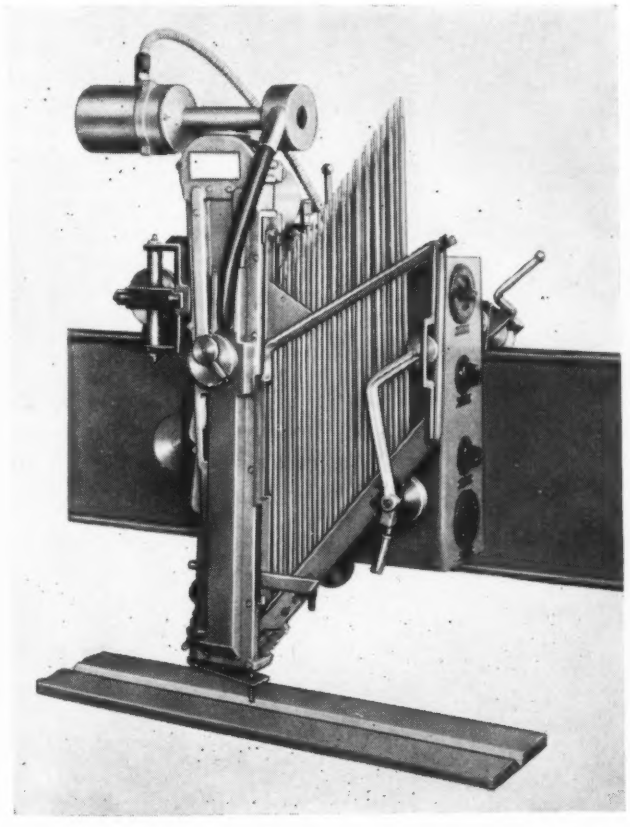
Philips Welding Electrode

A new type of manual arc-welding electrode, designed to improve weld quality and lower welding costs, was displayed at the recent National Metal Exposition in Philadelphia by the North American Philips Co., Inc., 100 E. 42nd St., New York 17, N. Y. These Norelco electrodes, available in lime, ferritic, iron oxide, and organic types, have a special kind of coating and offer certain definite advantages. Two of the electrodes can also be used on a semi-automatic basis, permitting "touch welding" in all welding positions except vertically upward. They have automatic starting and re-igniting properties and offer high deposition efficiency because of their low spatter losses and special coating. The electrodes work satisfactorily with standard welding equipment on alternating- or direct-current, reverse or straight polarity. 79

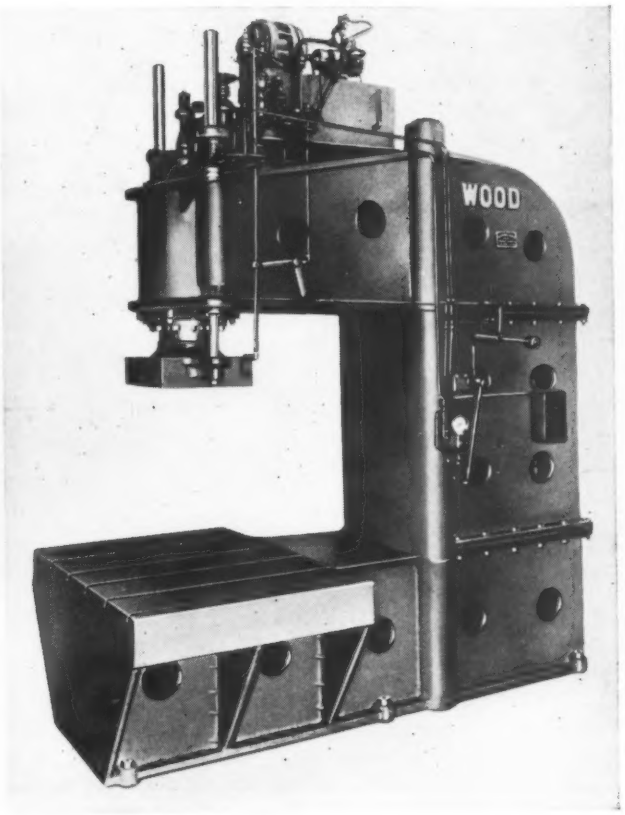
Wood "HydroLectric" Open-Gap Presses

A line of open-gap "HydroLectric" presses, made in various sizes and capacities, has been announced by the R. D. Wood Co., Public Ledger Bldg., Philadelphia 5, Pa. The machine illustrated is a 250-ton press used for flanging, bending, and straightening operations.

The table and ram head sizes of this machine are 30 by 30 and 8 by 6 inches, respectively. Hydraulic pressure is supplied by a 2000 pounds per square inch pump that displaces 17.7 gallons per minute. The presses, furnished complete with protective devices, safety valve, pressure gage, and all necessary valves and control equipment, are controlled by a single four-way operating valve connected by linkage to twin control levers mounted on opposite sides of the press. 80



Elge Portable Welding Head with Magazine Feed



Open-gap Type 250-ton Press Made by R. D. Wood Co.

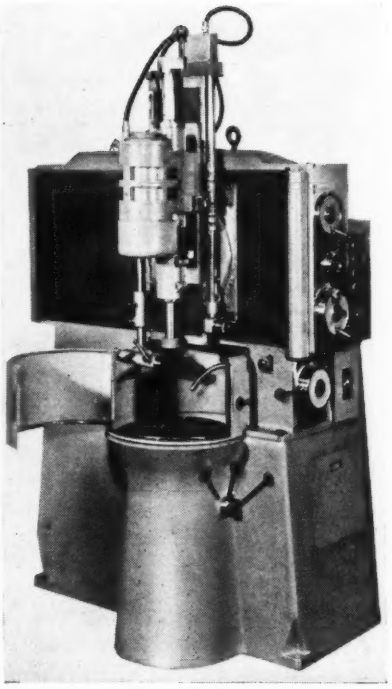
To obtain additional information on equipment described on this page, see lower part of page 228.

"Transfer-Matic" Equipped for Machining Transmission Gear-Shift Housing

A new "Transfer-Matic" type special machine equipped with a continuous automatic material-handling device has been brought out by The Cross Company, Detroit 7, Mich. This particular machine simultaneously performs fourteen operations on twenty-eight transmission gear - shift housings. The production rate is 175 pieces per hour. The operator merely pushes the control button, after which the machine automatically transfers, locates, clamps, and machines the parts progressively, two at a time. Standard interchangeable, self-contained units, available from The Cross Company, facilitate adapting the machine for different kinds of work. Easy accessibility of parts subject to wear assures low maintenance costs and results in a minimum of idle or "down" time. 81

Springfield Vertical Universal Grinder

A new TR series of vertical universal grinders has been brought out by the Springfield Machine Tool Co., Springfield, Ohio. The new models in this line of hydraulically operated vertical universal grinders are available in two sizes, with swing diameter capacities up to 32 and 24 inches respectively. The work is supported on a solid foundation, instead of being suspended, in order to improve visibility, facilitate setting up, and eliminate vibration. Features include swiveling wheel-head slide, solid adjustable stops, vertical feed, tarry control, and facing feeds. 82

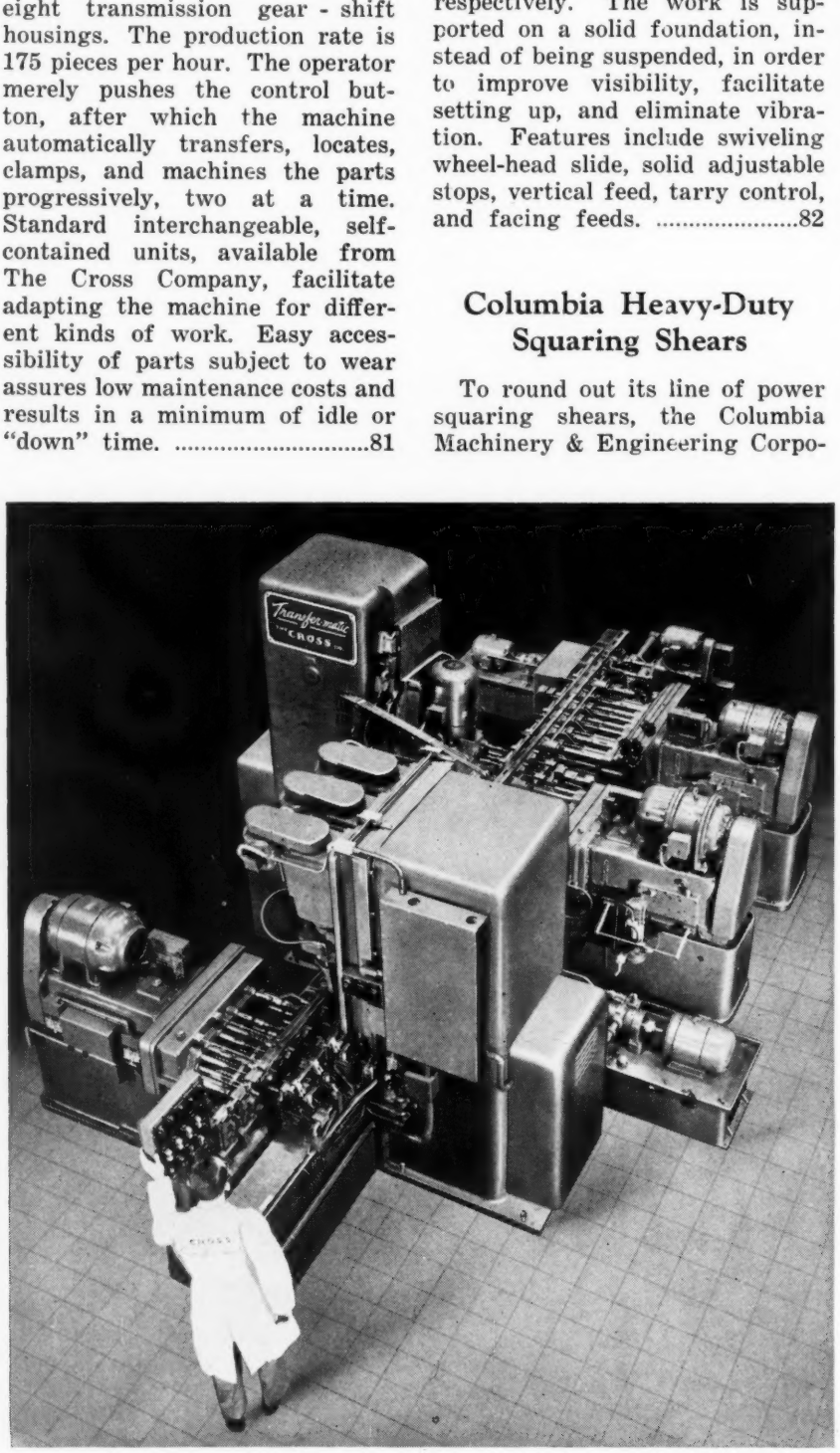


Springfield Hydraulically Operated Universal Grinder

Columbia Heavy-Duty Squaring Shears

To round out its line of power squaring shears, the Columbia Machinery & Engineering Corporation, Hamilton, Ohio, has brought out five new models with capacities for shearing mild steel of 6 feet by 3/8 inch, 10 feet by 3/8 inch, 6 feet by 5/8 inch, 10 feet by 1/2 inch, and 10 feet by 3/4 inch. These shears follow closely the design of the smaller models made by this company, but they have been strengthened to withstand the strain of cutting heavier material. The upper blade of each shear can be adjusted horizontally for alignment. Hydraulically operated, automatic hold-downs prevent creeping of the plate.

All new models are built with a motor stand and stainless-steel scale located in the shear table. The motor pulleys, V-belts, and belt guards, 50-inch front-gage, and 24-inch motorized back-gage are standard equipment. A 36-inch back-gage can be furnished on all models except the 3/4-inch shear. Accessory equipment includes a 120-inch squaring arm with a hinged gage and stainless-steel scale, remote-control foot switch, and line cutting gage...83



Special Cross "Transfer-Matic" Equipped with Continuous Automatic Material-handling Device

Automatic Unloading Device for Presses

The Sahlin Engineering Co., 467 S. Woodward, Birmingham, Mich., has designed an automatic work unloading device that enables manufacturers of sheet-

To obtain additional information on equipment described on this page, see lower part of page 228.

metal products to utilize the full production possibilities of their large presses by speeding the removal of stampings. This device, known as the "Iron Hand," is said to have increased production as much as 50 per cent in some instances. It also serves as a safety feature, since it makes it unnecessary for a worker to endanger his hands by removing stampings from a press.

The new unloader is self-contained, and can be installed on practically all types of presses. Since it does not depend on the press for its actuation, the unloader can be timed to remove the work during any portion of the upward stroke of the press ram. It can be arranged to lift the work vertically to any desired height before swinging it outward. This feature often eliminates the need for spring or air lift-outs in the lower die. Stampings can be turned over automatically by the device when required by the operating sequence.

The unloader is readily portable, and can be easily changed from one press to another. It is equally adaptable to open and enclosed type presses.

After the ram descends and completes the forming or shearing operation, the jaw of the unloader moves into the die and takes a firm hold on the stamping or work the moment the ram has moved upward a sufficient distance to permit removal of the work. The unloader "hand" lifts the work out of the die and swings it back onto a conveyor or table, after which it returns to its original position, in readiness for the next unloading movement. 84

Knight All-Steel Welded Press

The Knight Machinery Co., Indianapolis, Ind., has added to its line an all-steel welded press brake, known as Model 14B72, which has a rated capacity of 6 feet of 14-gage mild steel. The new machine has the same features and construction as the press brakes of the regular Knight line. This machine is especially designed to facilitate servicing. It is equipped with Zerk-Alemite fittings, electric controls, variable-pitch pulley drives, motors, and twin-disk clutches. 85

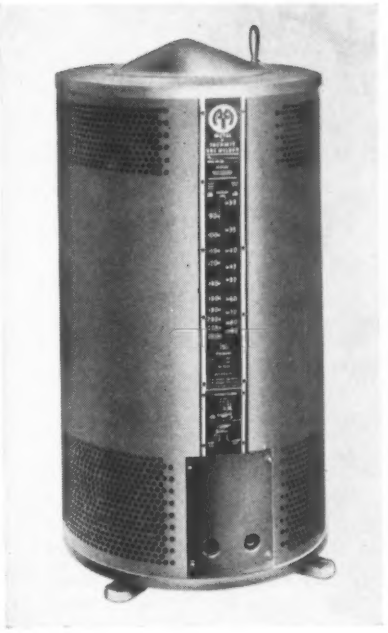
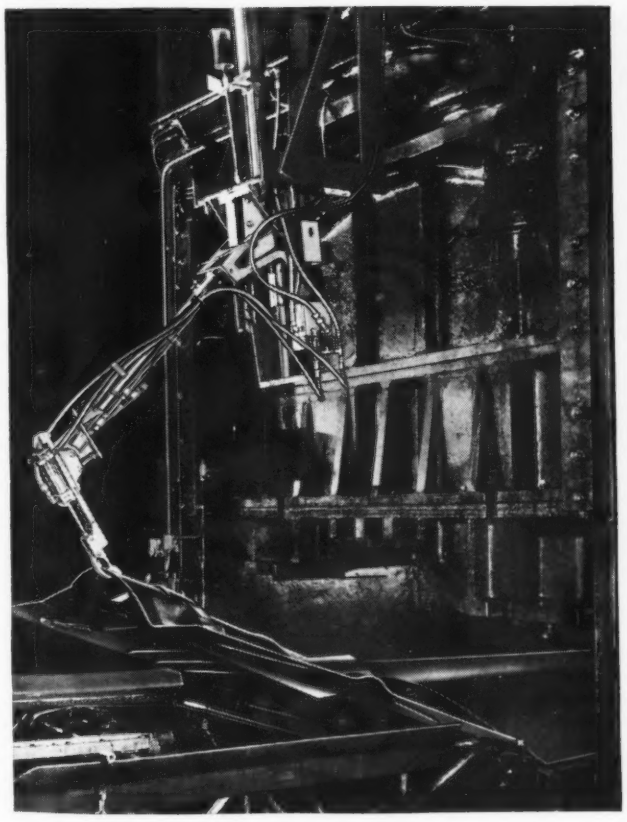


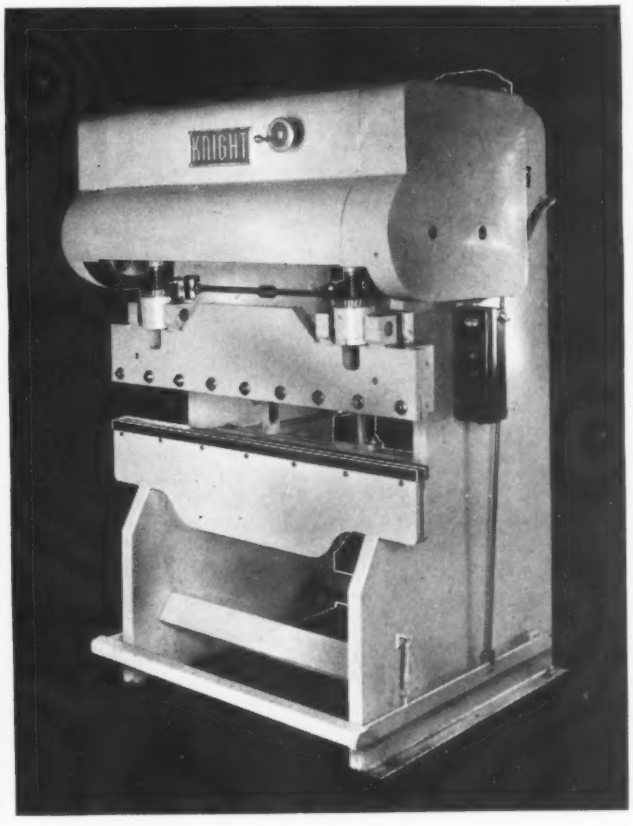
Fig. 1. Alternating-current Arc-welding Machine Brought out by Metal & Thermit Corporation

New Arc-Welders

The Metal & Thermit Corporation, 120 Broadway, New York 5, N. Y., has brought out a new line of alternating-current and direct-



"Iron Hand" which Automatically Removes Drawn Automobile Floor Pan from Press



All-steel Welded Press Brake Added to the Line of the Knight Machinery Co.

To obtain additional information on equipment described on this page, see lower part of page 228.

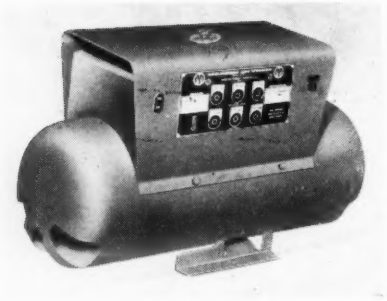


Fig. 2. Direct-current Arc-welder Built by Metal & Thermit Corporation

current arc-welding machines as companion equipment for their Murex electrodes and M & T welding accessories. The alternating-current unit, shown in Fig. 1, has a built-in power factor corrector; finger-tip, stepless current control; fan-forced ventilation; wide current range; and moderate open-circuit voltage operation. The units of the transformer type are available in 150-, 200-, 300-, 400-, and 500-ampere capacities.

The major design feature of all direct-current models is the one-dial, simplified control panel shown on the welder illustrated in Fig. 2. The panel has a series of well-marked outlets, each one for an electrode of different diameter. After plugging into the proper outlet, any required minor change in current is made by dial adjustment. Motor-driven direct-current units are available in 150-, 200-, 300-, and 400-ampere capacities in a new compact 3600-R.P.M. model and in conventional 1750-R.P.M. types. Engine-driven welders include 200-ampere units powered by air-cooled Wisconsin engines and 300- and 400-ampere sets driven by Chrysler industrial engines. 86

Grand Rapids Tap and Drill Grinder

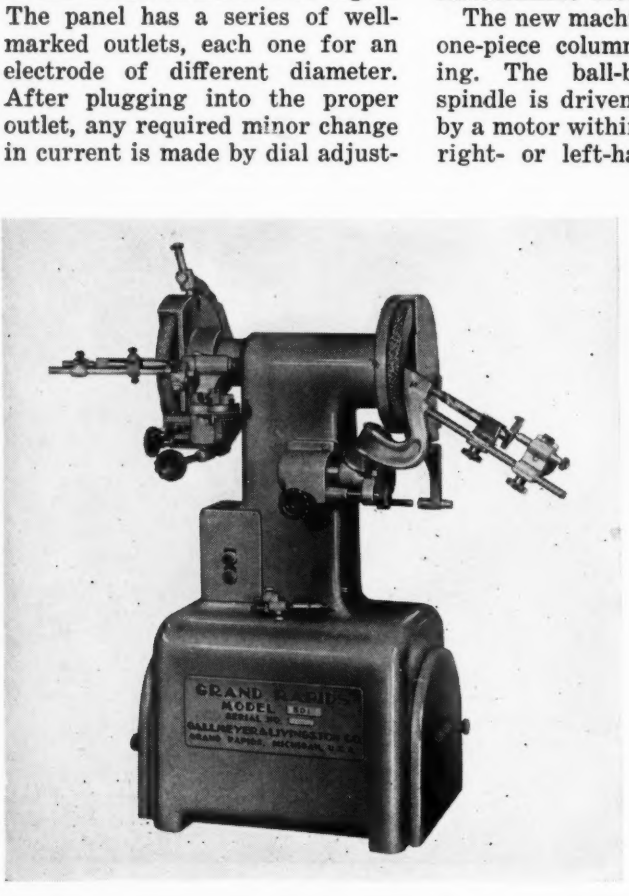
The Gallmeyer & Livingston Co., 305 Straight St., S.W., Grand Rapids 4, Mich., has brought out a complete new line of combination tap and drill grinders, including the new Style BD-1 machine illustrated. This machine has a capacity for sharpening taps from No. 6 to 1 1/2 inches, and twist drills from 1/8 to 1 1/2 inches. The machines in the new line combine the advantages of the regular Grand Rapids tap grinder and the Grand Rapids drill grinder in one machine, thus requiring but half the floor space and making possible the reduction of maintenance costs to a minimum.

The new machines have a heavy one-piece column and base casting. The ball-bearing mounted spindle is driven through V-belts by a motor within the base. Either right- or left-hand two-, three-, and four-flute taps can be sharpened with equal facility, and the holder can be adjusted to grind a very blunt taper, such as is required for bottoming taps, or the exceedingly long taper necessary for tapper taps. A diamond truing device is provided for dressing the tap grinding wheel.

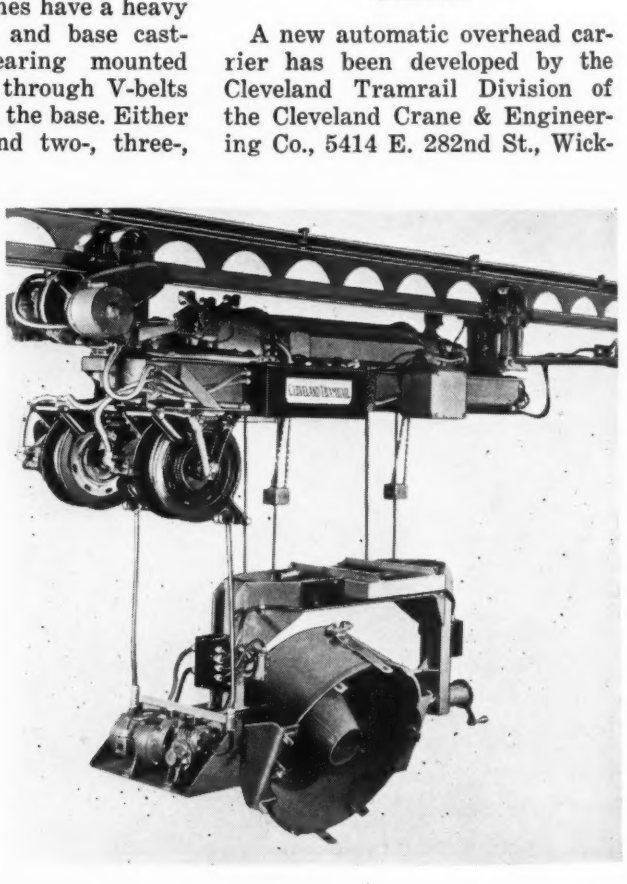
The twist drill grinding attachment is suitable for sharpening two-, three-, and four-flute twist drills of either straight or taper shank type. The only adjustment necessary when changing from one size to another is to slide the tailstock sufficiently to compensate for the difference in the drill lengths. A truing device is also provided for dressing the drill grinding wheel, which can be used without disturbing the setting of the drill-holder. This device operates in conjunction with the drill-holder so that, as the face of the wheel is dressed, the holder is automatically moved toward the wheel, thus maintaining a constant relationship between the holder and the wheel. 87

Automatic Chip-Handling Carrier

A new automatic overhead carrier has been developed by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., 5414 E. 282nd St., Wick-



Grand Rapids Combination Tap and Drill Grinder



Automatic Chip-handling Overhead Carrier

To obtain additional information on equipment described on this page, see lower part of page 228.

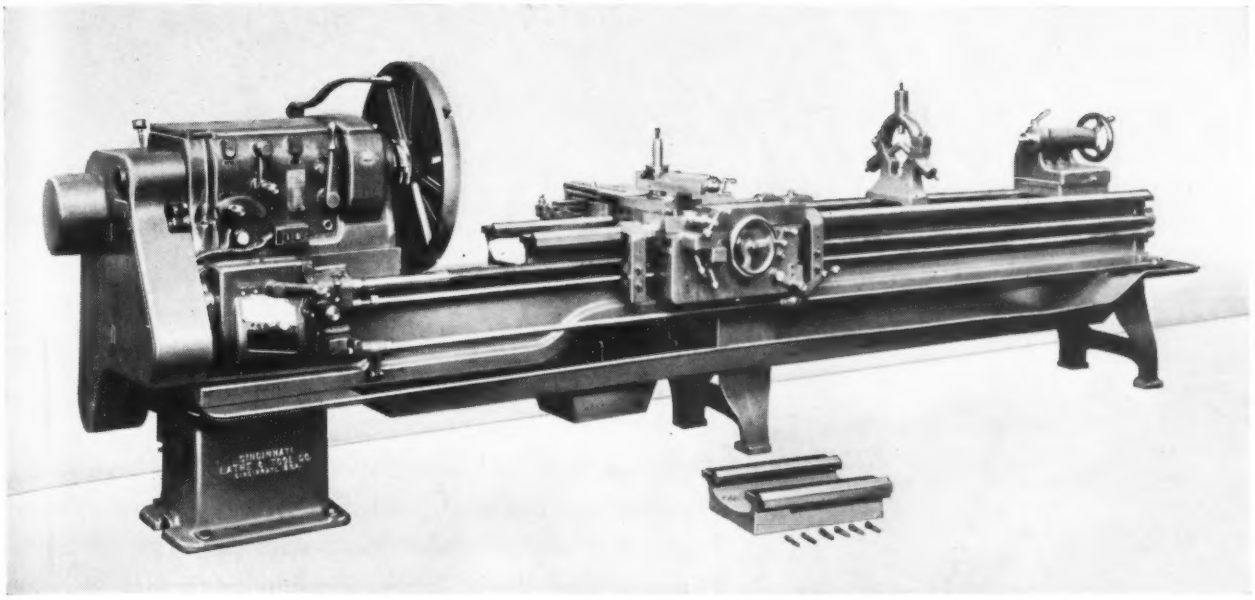


Fig. 1. Cincinnati Fixed-gap Bed Cintilathe

liffe, Ohio, for transporting baskets of metal chips from the oil extractor to any one of several storage bunkers. The carrier delivers the basket, empties it, and returns it automatically.

Baskets of approximately 15 cubic feet capacity, which take 1000-pound loads of chips, are handled by the carrier. A dial selector enables preselection of any station to which it is desired to dispatch a load. This particular selector will serve systems having up to four hundred stations. The traveling speed of the carrier is 200 feet per minute. 88

Granite Straightedges

Six-foot long straightedges made of granite to a tolerance of 0.00005 inch have been announced by the Rahn Granite Surface Plate Co., Dayton, Ohio. The precision method of generating the edges of these straightedges assures a high degree of accuracy. These straightedges are said to be harder than hardened tool steel and to be free from warpage or distortion caused by temperature changes or shock. If accidentally subjected to blows from a sharp object, no compensating hump will be raised at the point of impact.

Metal abrasives cannot become embedded in the surface, and there is no danger of lapping articles on which they are used. The company also produces 90-degree granite angle-plates to a tolerance of 0.00005 inch. 89

Fixed-Gap Bed Cintilathes

Cincinnati Lathe & Tool Co., Cincinnati 9, Ohio, has added a new series of "fixed-gap bed" lathes to its line of standard and "tray-top" motor-driven geared-head engine lathes. The fixed-gap bed Cintilathe shown in Fig. 1 is intended to meet the demands of repair and jobbing shops that require extremely versatile medium- and light-duty engine lathes.

The standard (medium-duty) fixed-gap bed Cintilathe is offered in six nominal swings—namely, 14, 16, 18, 20, 22, and 24 inches—with distances between centers ranging from 30 inches up, in increments of 24 inches. The motors supplied for these lathes are: 14-inch, 3 H.P.; 16-inch, 5 H.P.; 18-inch, 5 H.P.; 20-inch, 7 1/2 H.P.; 22-inch, 10 H.P.; and 24-inch, 15 H.P.

The gap provides an increase in capacity from the nominal swing of 14 inches to 24 1/2 inches for the smallest size lathe and from 24 to 38 1/2 inches for the

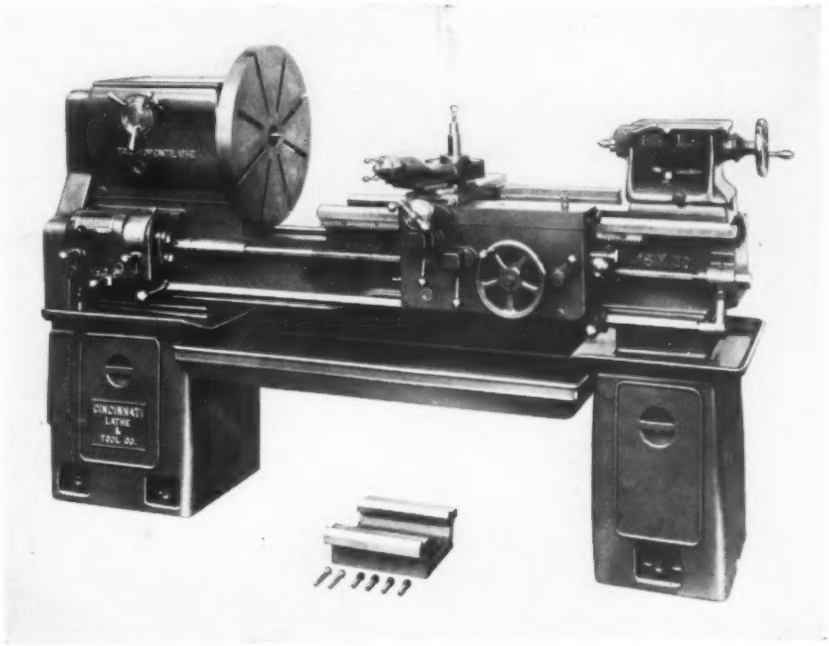


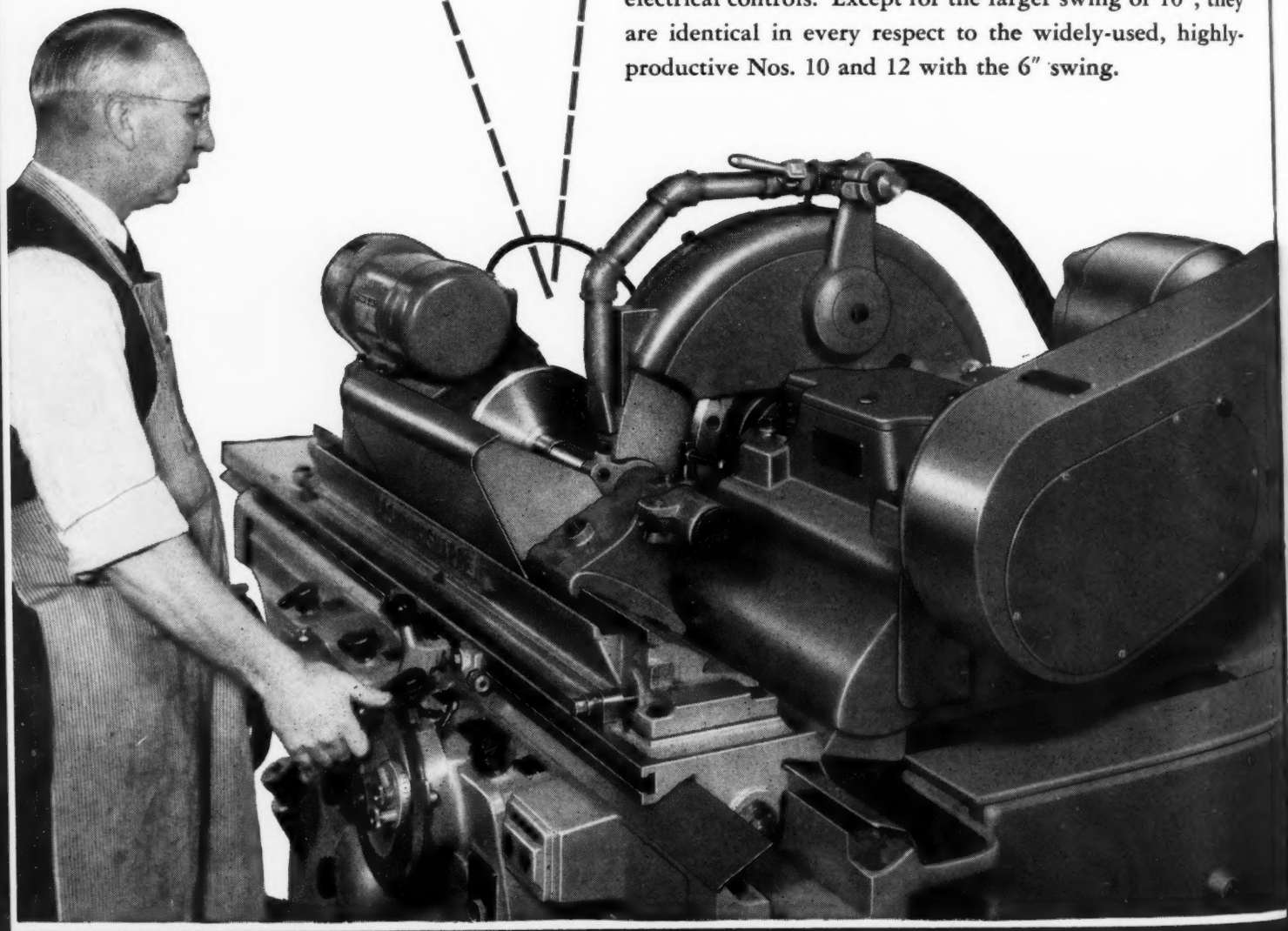
Fig. 2. Cincinnati "Tray-top" Light-duty Fixed-gap Bed Cintilathe

To obtain additional information on equipment described on this page, see lower part of page 228.

NEW! a 10" swing for Nos. 10 and 12

PROVIDES AMPLE CLEARANCE FOR LARGER DIAMETERS AND PROJECTIONS

THE NEW, 10" swing machines, like those with the 6" swing, are designed particularly for the rapid cylindrical grinding of small and medium-sized parts to close limits on a production basis. They can grind many parts to limits of .0001" tolerance with consistent uniformity on ground diameters up to 3". These machines are compact and self-contained and are operated by very simple hydraulic and electrical controls. Except for the larger swing of 10", they are identical in every respect to the widely-used, highly-productive Nos. 10 and 12 with the 6" swing.



BROWN &

Plain Grinding Machines

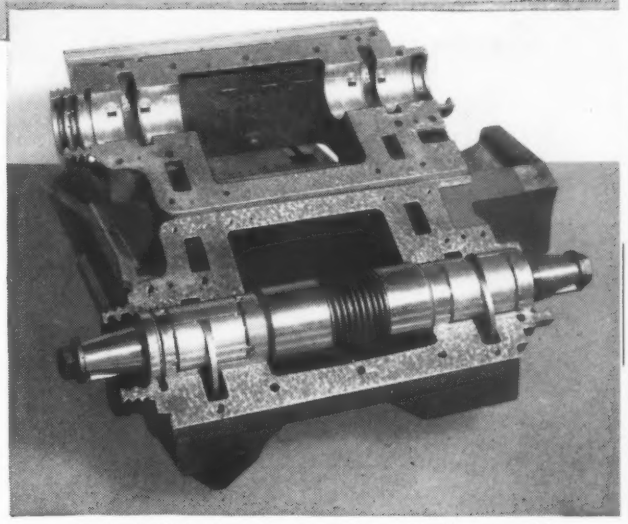
HIGHLY-PRODUCTIVE FEATURES OF TIME-TESTED NOS. 10 AND 12 MACHINES

ONCE THESE machines have been set for a given production job, they can be operated entirely by only two controls . . . the cross feed handwheel and the table start-stop knob.

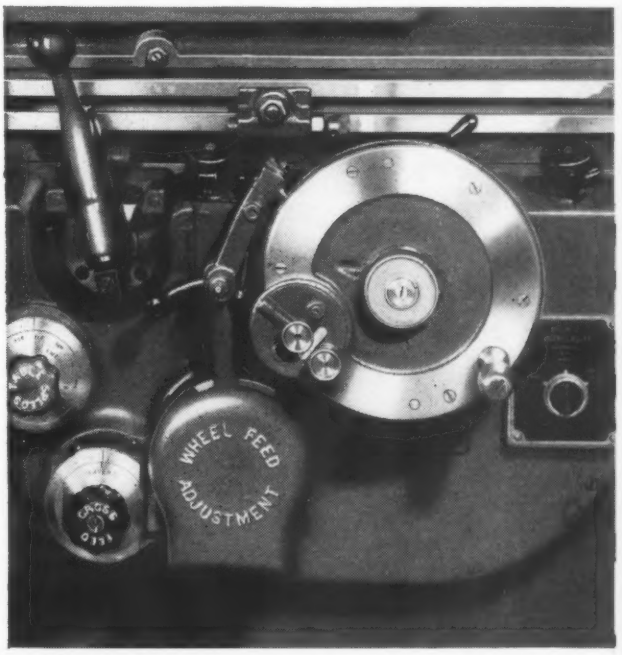
Their unique spindle design assures rapid, trouble-free precision grinding. Spark-out time is at a minimum due to unusually small clearance between spindle and its boxes—practically eliminating radial spindle play. The spindle is ground to extremely close limits of concentricity, straightness and finish and is lubricated with extra-light spindle oil.

Correct adjustment of spindle boxes is quickly and positively obtained with the spindle running . . . a very simple job.

Other up-to-the-minute advantages include time-saving knob controls, individual motor drives, cross feed mechanism with adjustment to .0001" on diameter and automatic oiling. They all add up to surer, easier operation that means faster, better production. Write for Bulletin. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.



Wheel slide showing precision spindle assembly.



Cross feed handwheel—controls advance and withdrawal of grinding wheel and start-stop of headstock and coolant.

CAPACITIES

6" Machines, No. 10 (6" x 18"), No. 12 (6" x 30"). Centers swing 6 11/16" diameter over table. Distance center line of work to center of wheel spindle, greatest, 14 1/8", least 7 5/8".

10" Machines, No. 10 (10" x 18"), No. 12 (10" x 30"). Same grinding capacities as 6" except centers swing 10 7/8".

SHARPE B·S

largest size. The approximate distance from end of spindle nose to end of gap is 10 inches for the smallest lathe and 18 1/2 inches for the largest size.

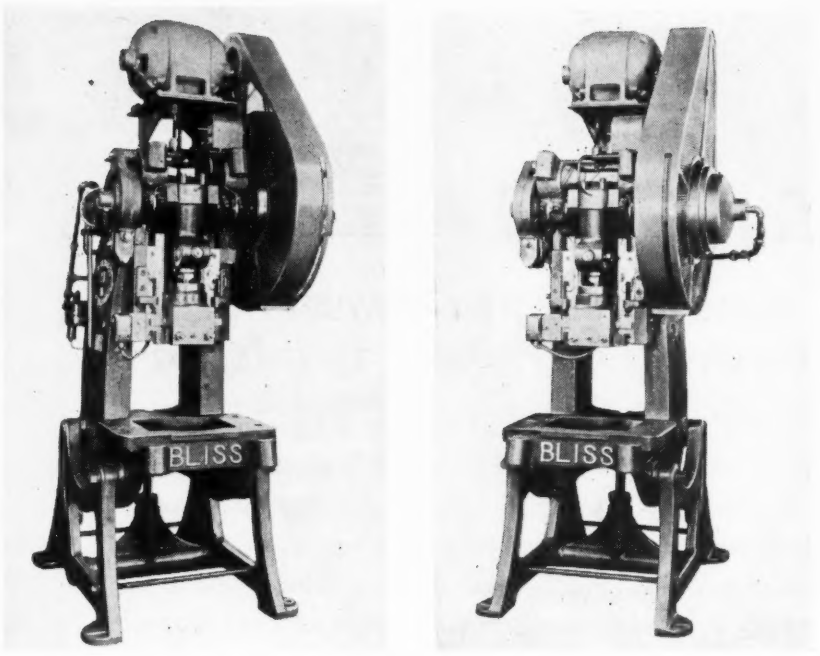
The new "tray-top" (light-duty) fixed-gap bed Cintilathe, shown in Fig. 2, is made in two nominal swings—15 and 18 inches—with distances between centers from 18 inches up, in increments of 6 inches. The motors supplied for these lathes are 2 H.P. for the 15-inch lathe and 3 H.P. for the 18-inch lathe. The gap provides an increase from 15 to 22 inches swing for the smaller size lathe, and from 18 to 25 inches for the larger size. 90

"Reduceroll" for Pre-Forming Forging Blanks

A machine known as the "Reduceroll" has been developed by the National Machinery Co., Tiffin, Ohio, to reduce or pre-form forging blanks by rolling, thus accurately distributing the stock to meet the requirements of final forging. This machine, being a separate unit, can be used in connection with hammers or forging presses, and does the same work as the "Maxiroll," the auxiliary pre-forming attachment of the "Maxipres."

The machine is equipped with an air-controlled friction clutch, which is tripped for each pass by a foot-pedal. The circular rolls are overhung to permit easy feeding, accessibility, and quick changing. The motor is geared to the flywheel, and is enclosed in the base. This machine is built in five sizes, covering the range of forging jobs that can be handled by the complete "Maxipres" line. 91

"Reduceroll" Brought out by National Machinery Co. for Pre-forming Forging Blanks



Bliss 35-ton Non-geared Inclinable Press Equipped with Pneumatic Friction Clutch, Shown in View at Right, and with Clutch-timing and Brake-releasing Mechanism, Seen in View at Left

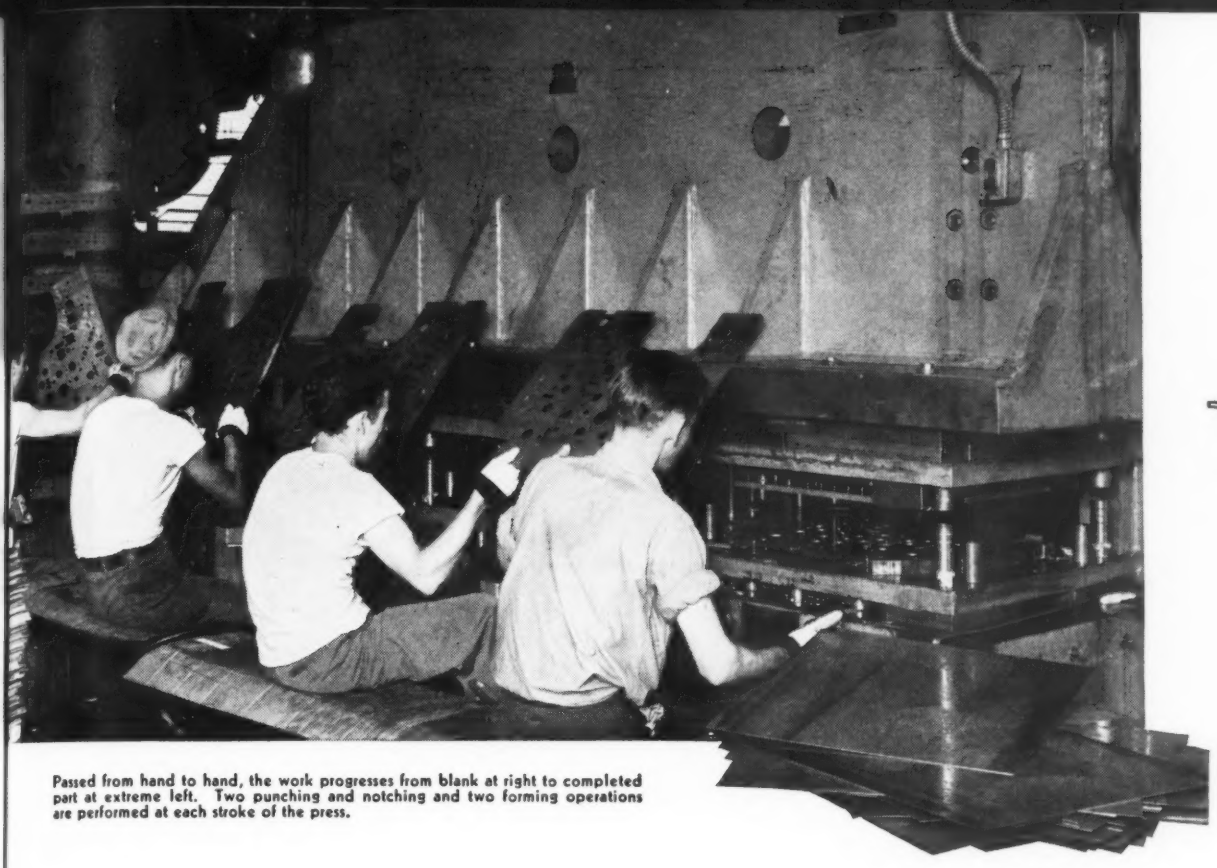
Bliss Inclinable and Small Geared Presses Equipped with Pneumatic Friction Clutch and Brake

Standard flywheel type inclinable presses, as well as the smaller geared presses, built by the E. W. Bliss Co., 450 Amsterdam Ave., Detroit 2, Mich., can now be equipped with the pneumatic friction clutch and brake previously provided only on large geared inclinable presses. This clutch equipment permits the press to be stopped at any point in the stroke to avoid injury to the operator or damage to the dies. In addition, it provides for an "inching" action to facilitate setting up certain types of dies. The press can also be reversed, if necessary, to allow the punch to be backed away from the die without completing the stroke. 92

Coolant for Metal and Plastic Machining

The Machine Tool Specialties Division of Arnold, Hoffman & Co., Inc., Providence, R. I., has brought out a new coolant known "Ahcowet CG" for solving friction and heat reducing problems in metal and plastic machining operations. This coolant is designed to quickly penetrate grinding wheels and cutters. The transparency of the oil allows the operator to work to closer tolerances. As an emulsion (readily soluble in nat-

To obtain additional information on equipment described on this page, see lower part of page 228.



Passed from hand to hand, the work progresses from blank at right to completed part at extreme left. Two punching and notching and two forming operations are performed at each stroke of the press.

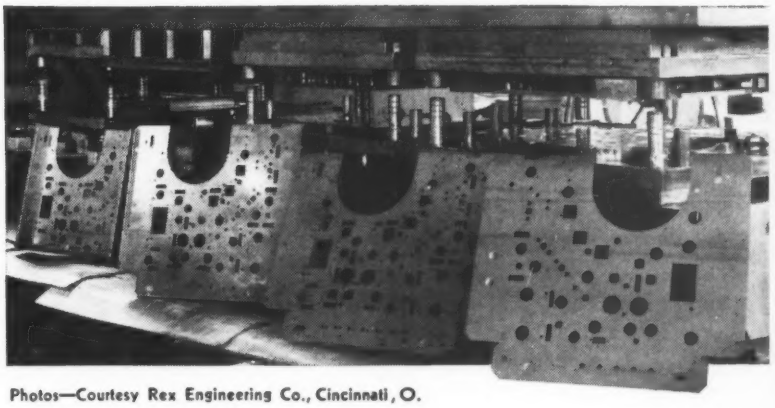
OPERATION TELEVISION...

This television chassis, a modern product made in the modern manner on a Cincinnati Press Brake, is produced from blank to completion in one stroke—four simultaneous operations on one machine.

281 holes, tabs and notches are punched, and three sides are formed at each stroke—to close tolerances.

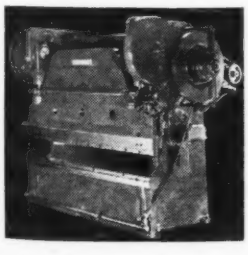
Cincinnati wide beds and rams—either fixed or detachable—for large area work, are highly productive on jobs of this kind.

You may find you can do it for less on a Cincinnati Press Brake.



Photos—Courtesy Rex Engineering Co., Cincinnati, O.

Write for technical Bulletin 135. a compact treatise on Press Brake practice, dies and applications.



THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

ural water supplies) it remains permanently in solution at all normal working temperatures. Its odorless, non-irritating, rust inhibiting, and friction reducing qualities make this compound an efficient cutting and abrasive coolant for most machining operations. 93

Lord Multiple-Horsepower Couplings

Lord Mfg. Co., Erie, Pa., has announced a new line of multiple-horsepower couplings in a capacity range of from 2 to 100 H.P. at a speed of 1750 R.P.M. The company's complete line now includes seventeen sizes ranging from 1/50 to 100 H.P. The 1/50- to 15-H.P. couplings have a 15-degree torsional deflection under the rated load, and the 30- to 100-H.P. sizes have a 3-degree torsional deflection. The couplings will accommodate at least a 2-degree angular and a 1/32-inch parallel misalignment.

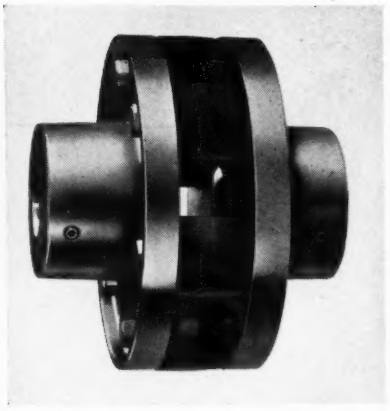


Fig. 1. Lord Couplings Made in Capacities of 20 to 100 H.P.

Fig. 2. Design of Couplings Made in Capacities of 2 to 15 H.P.

The flexible neoprene elements of the couplings operate in shear and are bonded to steel plates. Since there are no bearing surfaces, the couplings require no lubrication. 94

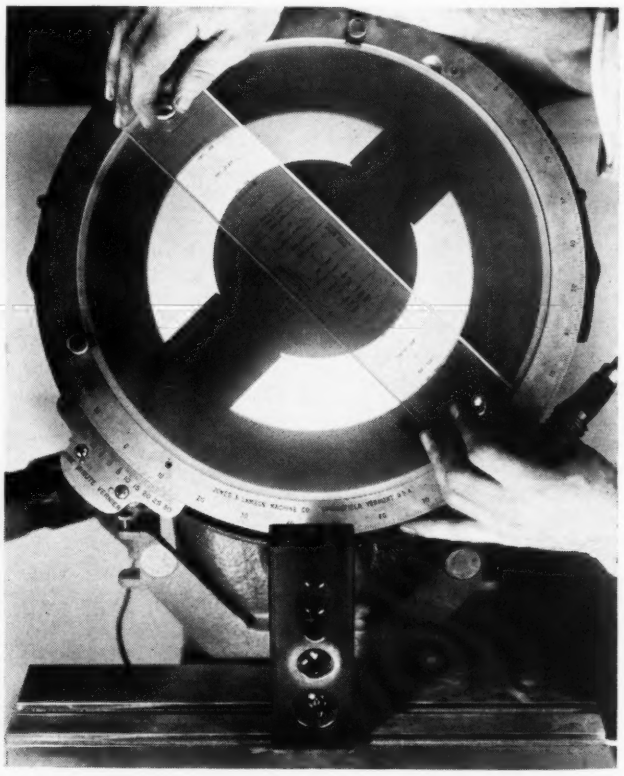
Magnification Checker for Optical Comparators and Projectors

The Engineers Specialties Division, 980 Ellicott St., Buffalo 8, N. Y., has brought out a magnification checker designed to accurately check the mirror adjustments and magnifications of the lenses of all types of optical comparators and projectors. The diameters of the steel balls and pin of this checker, shown in Fig. 1, are held to an accuracy of 0.000025 inch. The balls are suspended by spring-loaded pins in openings in an aluminum bar.

The center of the 0.0625-pin is located an equal distance from the side and one end of the bar to permit checking the magnification horizontally and vertically by placing the bar on the work-table of the comparator, first on the end and then on one side. After the magnification checker has been placed on the table, one of the four precision-ground balls or the single pin is projected and the shadow measured on the chart gage screen. This is accomplished by the magnification gage lines incorporated on all ESD lay-out chart gages or by using the magnification checking scale shown in Fig. 2. Various sections of an inspection screen can also be checked

Fig. 1. (Below) Magnification Checker for Optical Comparators Made by Engineers Specialties Division

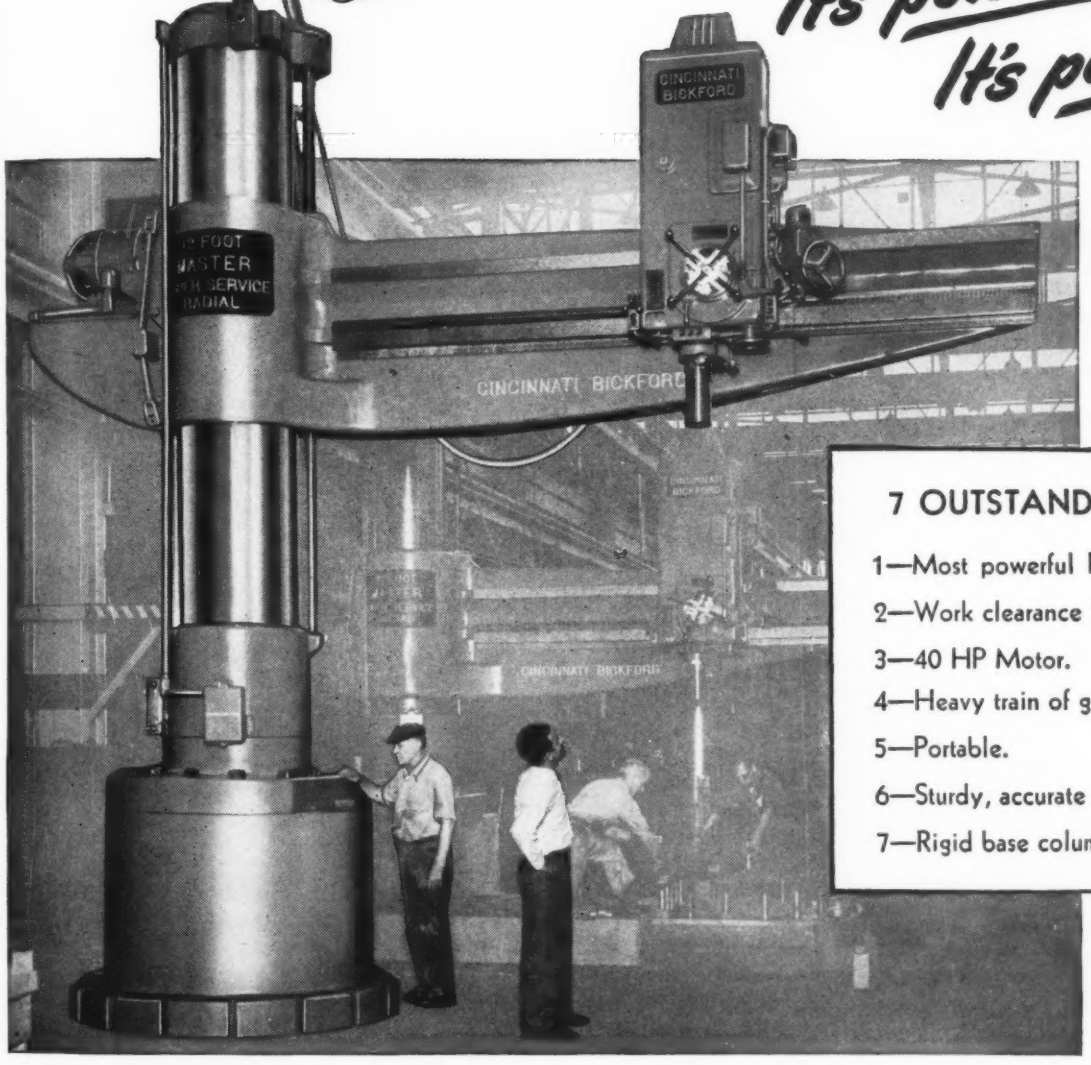
Fig. 2. (Right) Magnification Checking Scale Used with Steel-ball Checker Shown in Fig. 1



To obtain additional information on equipment described on this page, see lower part of page 228.

with 14' 4" clearance

It's massive— It's powerful— It's portable



7 OUTSTANDING FACTS

1—Most powerful Radial ever built.

2—Work clearance 14' 4".

3—40 HP Motor.

4—Heavy train of gears.

5—Portable.

6—Sturdy, accurate spindle.

7—Rigid base column and arm.

THE CINCINNATI BICKFORD TOOL CO.

RADIAL AND UPRIGHT DRILLING MACHINES

SUPER SERVICE

Radials 7½" dia. col., 2½" arm, to 96" dia. col., 12' arm.
General purpose Uprights, 21" to 28" sizes.
Production Uprights, 21" to 28".
Jig Borers, Portable Horizontals, Spacing Table Machines.

Equal Efficiency of Every Unit Makes the Balanced Machine

To our knowledge the largest and most powerful Radial Drill ever built, this Cincinnati Super Service Master Radial Drill, with a 40 horsepower motor, is being used as a portable machine on very large and heavy work.

This massive machine, built like a watch, handles easily, and gives continuous, trouble-free service on the heaviest of jobs.

Write for Bulletin R-22 or consult our Engineering Department on your drilling problems.

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

Chambersburg Air- or Steam-operated General-Utility Hammer

New Model Parkson Gear Tester Announced by George Scherr Co.

for uniformity of image magnification. The straight and curved rulings are accurately located at the exact diameter size for the various standard magnifications of 10X, 20X, 31.25X, 50X, and 62.5X. 95

Chambersburg Utility Hammer Made in Wide Range of Sizes

The capacity range of general-utility air- or steam-operated hammers built by the Chambersburg Engineering Co., Chambersburg, Pa., has been extended. Now made in a range of sizes from 50 to 500 pounds falling weight, the hammers are adapted to handle a wide variety of jobs, from tool dressing to emergency forging. No foundation is required, and installation is simple.

The frame and anvil are cast in one piece, which insures accuracy when dies are employed. Heat-treated and ground flat dies facilitate work manipulation and enable the hammer to forge the tougher steels with fewer redressings. An automatically lubricated cylinder reduces operating costs. The piston-rings are induction-hardened to prolong their wearing qualities. A self-seating rotary type valve directly connected to the throttle control gives greater air or steam efficiency. 96

Parkson Gear Tester for Spur and Worm Gears

The new model Parkson gear tester, announced by George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y., has several improved features designed to facilitate the checking of spur and worm gears. Improvements have also been incorporated in the tester to save time in setting up by eliminating the need of making special fixtures or bushings when changing over from one job to another.

The illustration shows the machine with a typical worm-gear set-up. The worm, which is integral with the shaft, rests in two V-brackets. In this particular case, the worm-shaft has two different diameters for which compensation is easily made by the adjustable Parkson V-bracket supports. Holding-down devices are provided for each side of the shaft. When desirable, the V-blocks for supporting the worm-shaft can be replaced by a pair of cylindrical bushings or a pair of centers. The swiveling worm-carriage head has graduations in degrees and a vernier to give angular readings that are accurate to 5 minutes.

When the machine is required for checking spur, helical, or herringbone gears, the worm slide is removed, freeing the taper bore in the floating slide. 97

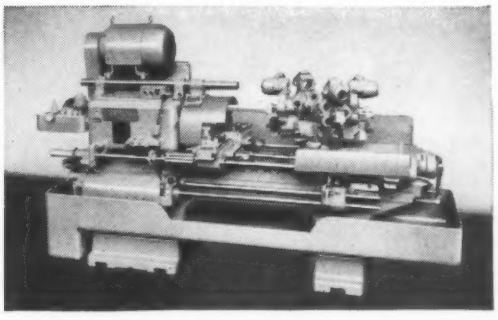
"Steam Homo" Tempering Furnace

Scale-free tempering and strain relief of metal parts are being accomplished by the "Steam Homo" method with this furnace and equipment, recently developed by the Leeds & Northrup Co., 4934 Stenton

To obtain additional information on equipment described on this page, see lower part of page 228.

GISHOLT
Fastermatics
(AUTOMATIC TURRET LATHES)

This simple control drum enables you to select the BEST feed for EACH cut because the Fastermatic provides infinite feed selection rather than limited and fixed gear ratios. Thus it makes feed selection efficient, quick and easy. Write for literature.



THE GISHOLT ROUND TABLE represents the collective experience of specialists in machining, surface-finishing and balancing of round or partly round parts. Your problems are welcomed here.

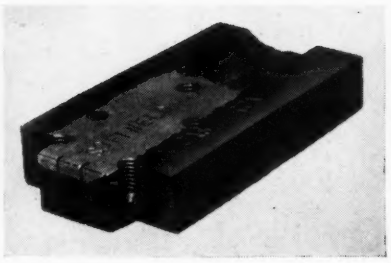
GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

Turret Lathes · Automatic Lathes · Superfinishers · Balancers · Special Machines

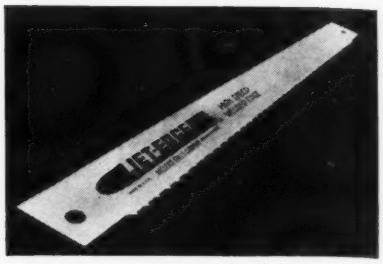
Ave., Philadelphia 44, Pa. High-speed steel tools, cast iron, sintered powdered iron, and non-ferrous alloys can be treated with this equipment at temperatures up to 1150 degrees F. By using a protective steam atmosphere in connection with Homo forced-convection heating and Micromax temperature control, the furnace can be used to turn out steel parts with a uniform blue oxide finish. These parts have improved machinability, increased resistance to corrosion and wear, and are easier to clean for subsequent plating. 98

Lincoln "Softweld" Electrode

A cast-iron part with deposit of "Softweld" which can be readily cut, drilled, and tapped, even at the fusion



line, is shown in the illustration above. The new "Softweld" electrode deposits a dense, soft, machinable weld in gray-iron castings and operates with a soft steady arc on either alternating or direct current. Can be used for building up broken edges on parts, restoring broken gear teeth, and filling holes in defective castings. Softweld is available in 14-inch lengths. Brought out by the Lincoln Electric Co., Cleveland 1, Ohio...99



Welded-Edge Hacksaw

Super high-speed hacksaw blade introduced by the Millers Falls Co., Greenfield, Mass. The new blade, called the "Jet-Edge," is said to be shatter-proof and unbreakable. The extremely hard edge of this blade is also said to have a high degree of resistance to abrasion, keeping the teeth in cutting condition longer and enabling the blade to cut faster..100

Carbide Tool Grinder

A new carbide tool grinder announced by the U. S. Diamond Wheel Co., 707 Illinois Ave., Aurora, Ill. Equipped with small-diameter wheels for grinding tools up to 1-inch shank sizes. Operates at a spindle speed of 9000 R.P.M. The diamond wheel has a full 3/4-inch wide grinding surface for off-hand grinding. Easily read scales are provided for angular table setting. All-angle vise facilitates quick set-ups for chip-breaker grinding. Has provision for wet grinding. Equipped with cabinet, 1/3-H.P. motor, coolant pump, wheel guards, and two diamond wheels. Requires a floor space of 24 by 24 inches, weighs 275 pounds and is obtainable in single-end, double-end, or off-hand and chip-breaker models. 101

Hill Pneumatic Riveting Machine

High-speed, adjustable-impact, production riveting machine with controlled time cycle. Hammer spindle is automatically rotated during oscillation by a small air motor. If required, air motor can be removed and the splined piston locked against rotation. The machine can be obtained with either a stationary or elevating type anvil, both of which are adjustable. Two types of work-tables are available—a 6 1/2- by 6 3/4-inch cast-iron table, generally supplied on machines having a stationary anvil, and a 40-by 24-inch plywood table, which can be attached to the column and which is especially adapted for high-production work on small parts. Announced by the Hill Machine Co., 1032 Mulberry St., Rockford, Ill. 102

To obtain additional information on equipment described on this page, see lower part of page 228.

Thousands of 'em!

Thousands of Precisionaire standard semi-finished gaging plugs are carried in stock for quick delivery.

Shipments made within one week from receipt of complete information—24 to 48 hours in emergencies.

This world's largest stock of "immediately available" air gage tooling protects Precisionaire users against production holdups or shutdowns.

Sheffield's interest does not diminish with the purchase of a Precisionaire. The instrument must be kept constantly useful. Quick tooling service from this great stock assures you uninterrupted performance throughout the long life of the instrument.

It is wise and thrifty to specify Sheffield.

5009

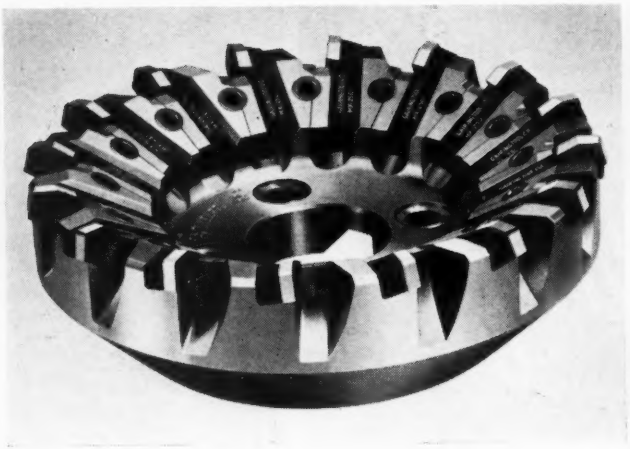
Sheffield's principal products include Gages, Measuring Instruments, Machine Tools, Threading Tools and Contract Services. Standard Gages shipped within 24 hours.

the Sheffield corporation

DAYTON 1, OHIO, U. S. A.

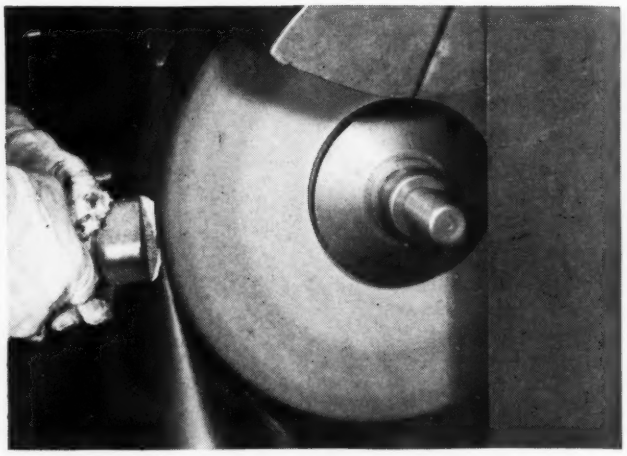
MASTER CRAFTSMEN SHEFFIELD HEADQUARTERS

5009



Heavy-Duty Face Mill

Heavy-duty face mill added to the E-Con-O-Mill line of standard face mills manufactured by the Gairing Tool Co., 21225 Hoover Road, Detroit 32, Mich. Designed for roughing operations, where the greatest wear occurs along the periphery of the tool. Blades are set at an angle to allow greatest adjustment in a radial direction. Extra heavy cutter bodies are made in 8-inch diameter sizes and larger. All sizes are equipped with the same tungsten-carbide tipped blades and locks used on the regular cone type E-Con-O-Mill. Blades are of three types—for cutting steel, cast iron, and non-ferrous material—and are finish-ground, ready for work. 103



Contact Wheel for Abrasive Belt

New contact wheel designed for heavy grinding with abrasive belts at speeds of 10,000 surface feet per minute or more, announced by Minnesota Mining & Mfg. Co., 900 Fauquier Ave., St. Paul 6, Minn. The major advantages claimed are faster and cooler stock removal, lower production costs, and chatterless operation. Especially adapted for work requiring heavy stock removal, such as grinding gates and flashings on castings, cutting down welds, and grinding through scale on forgings. The "K" contact wheel is made in 8- and 16-inch diameters and in face widths of 2 to 6 inches for use with cloth belts coated with silicon carbide or aluminum-oxide mineral grains. . . . 104

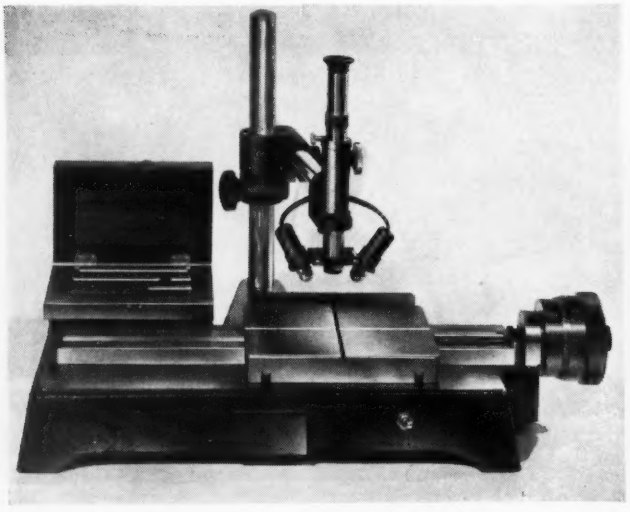
Toolmaker's Microscope

Measuring microscope brought out by the Boeckeler Instrument Co., 31 E. Rillito St., Tucson, Ariz. This instrument has been developed to meet the need for a low-priced toolmaker's microscope capable of covering a wide range of measurements with rapidity and a high degree of accuracy. It is designed for constant use in the toolroom and is built to withstand rough use. Objects up to 7 inches high can be placed under the microscope objective. The micrometer head is provided with a scale on the barrel which can be tilted to make corrections for any lead-screw error. Regularly furnished with 32X power magnification, but higher power objectives and eye-pieces can be added. The gage rods are hardened, carbide-tipped, and lapped to a tolerance of 0.000025 inch. 105

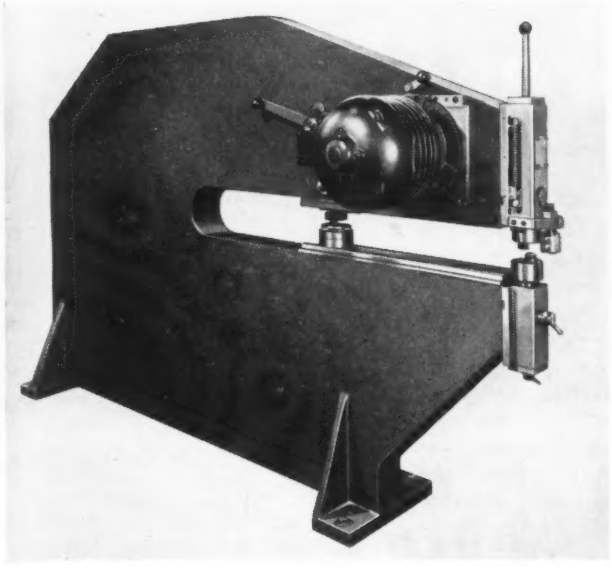
Taber Abrasion Testing Set

A new abrasion testing set has been announced by the Taber Instrument Corporation, Department M, 111 Goundry St., North Tonawanda, N. Y. The wear results from alternately rubbing the flat faces of two resilient abrasive wheels over the surface being tested. A range of standardized abrasive wheels is available for testing all types of finishes, including organic coatings and plastics.

The control unit is equipped with a built-in variable transformer for adjusting the speed of the suction turbine motor. The control panel is also provided with an adjustable timer to provide a test period of 1000 cycles or less. The set is arranged for dual operation, permitting two specimens to be tested simultaneously. Three testing sets are offered for various types of testing. 106

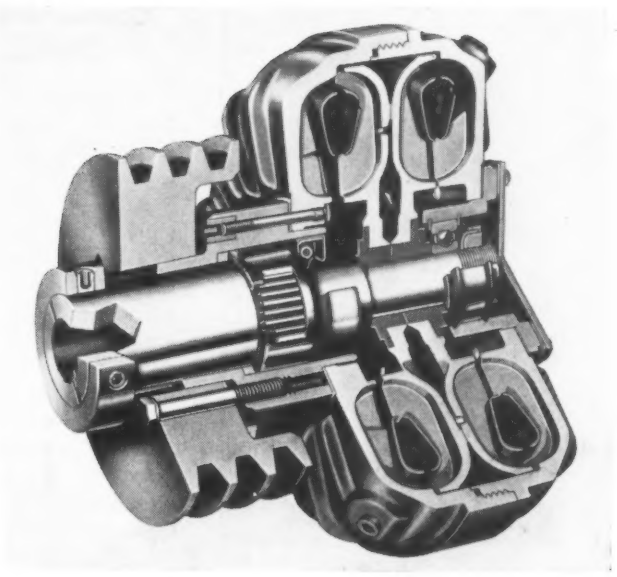


To obtain additional information on equipment described on this page, see lower part of page 228.



Truedge All-Purpose Shear

Low-cost cutting machine built for general shop use is announced by Elge Associates, 16 E. 71st St., New York 21, N. Y. This machine, in a successive, fast shearing action, produces a continuous cut with a finished, burr-free edge. The machine will cut any material within its capacity. It does not punch the material but shears it by a new method which eliminates resistance to the feeding and turning movements. The lower tool remains stationary while the upper tool, which is spring-loaded, reciprocates vertically at cutting speeds of 10 to 40 feet per minute, depending on the material. It will cut stainless steel up to 6 U. S. gage and mild steel up to 5 gage. Power is furnished by a 3/4-H.P. motor. No extra equipment such as pilots, strippers, or templets is required. Irregular shapes and small circles are readily cut, using curved tools. Circles as small as 9 inches in diameter can be easily cut. Straight tools are used for cutting straight edges and large circles. Only two adjustments are required, the length of stroke and the depth of penetration. The machine is 66 inches high, 24 inches wide, 86 inches long, and has a throat depth of 51 1/2 inches.....107

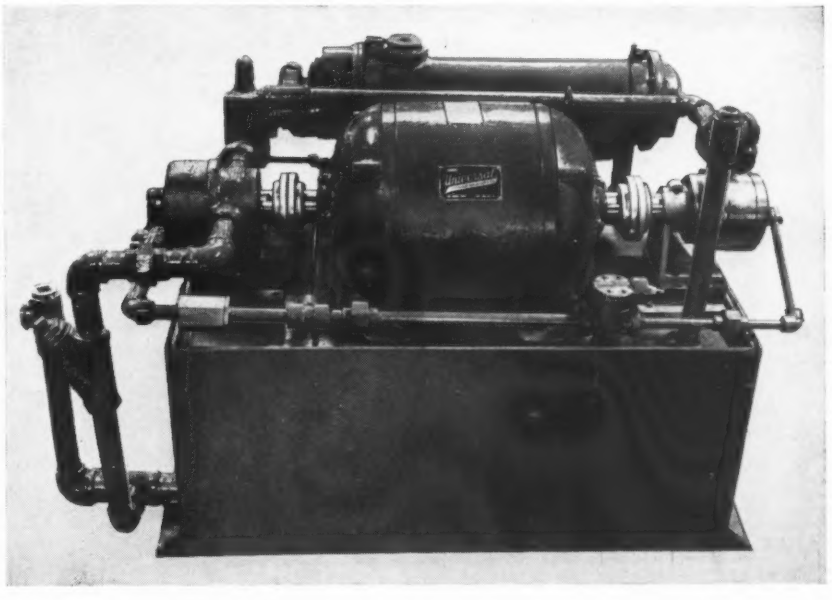


Hydro-Sheave Drive for Small Motors

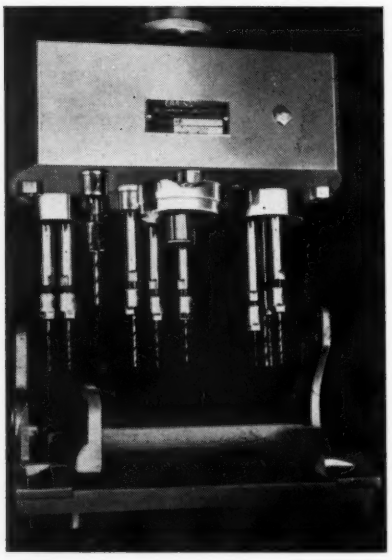
Hydro-sheave drive for small electric motors and internal combustion engines, brought out in five sizes by the Hydraulic Division, Twin Disc Clutch Co., Rockford, Ill. This small twin-disk hydraulic coupling smooths out the flow of power from motors or engines. It is intended especially for use with Worthington quick-detachable V-belt sheaves, being provided with a sleeve which slides directly over the output shaft of any small electric motor or engine. In this drive, oil is the only medium of power transmission. Incoming power from the electric motor or internal combustion engine rotates the hydraulic coupling inner member, the blades of which throw a continuous stream of oil against the vanes of the outer member or housing. The rotation of the housing with its attached sheave or sprocket provides an uninterrupted flow of power to the driven equipment. Any sudden shock or overload is absorbed by the fluid in the hydraulic coupling, and torsional vibrations are effectively dampened out by the fluid. The coupling is reversible, and will transmit torque in either direction. It can be installed in either a horizontal or vertical position. 108

Dual Pumping Units

Dual pumping unit made in all sizes, with capacities from 12 to 40 gallons per minute at 250 pounds per square inch, and from 1.25 to 5 gallons per minute up to 5000 pounds per square inch. Mounted on reservoir with relief and unloading valves and double-end motors ranging from 3 to 15 H.P. Equipped with oil cooler. Brought out by the Universal Hydraulic Machinery Co., 285 Hudson St., New York 13, N. Y. 109



To obtain additional information on equipment described on this page, see lower part of page 228.



Standardized Hydraulic Punching Units

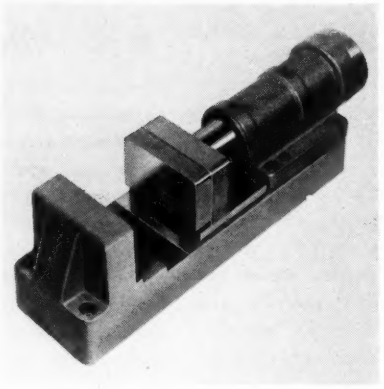
One of a new line of standardized hydraulic punching units with cylinders that are interchangeable on different bases, announced by the Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich. These units are of compact design, and are capable of delivering almost one-third more force than is usually obtained with cylinders of the size used. They can be employed for almost every production job involving punching, shearing, notching, trimming, or forming, eliminating the need for large presses and cam or other costly dies. Available in eight different types of base mountings and in 2- to 6-inch diameters, with strokes of 1 to 6 inches. These units can handle working pressures up to 2500 pounds per square inch. 111

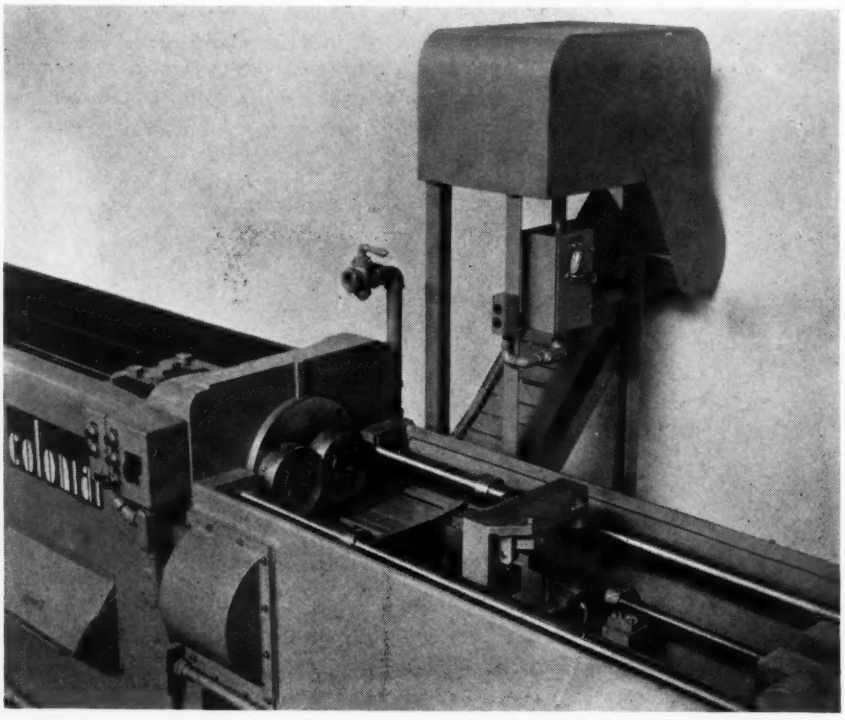
"Microtrip" Safety Device for Controlling Tripping Mechanism on Presses

Micro Switch, Freeport, Ill., has just announced a new two-hand, easily operated, electrical device for safe control of tripping mechanisms on punch presses. The device is also adapted for use on riveting machines, shears, spot-welders, and air-actuated presses. Light-touch actuation—from 10 to 18 ounces—reduces operator fatigue, and in some instances, has resulted in a 10 to 25 per cent increase in production. This device insures that both hands of the operator are out of the hazard area while the press ram is in motion. It is easily and quickly installed. 112

Errington Ten-Spindle Multiple Drilling Head

Ten-spindle multiple drilling head designed for drilling ten holes of various sizes at different levels or elevations. This head has grooved thrust ball bearings at all thrust points and hardened bronze radial bearings. The heat-treated spindles and gears are made in one piece and are turned from solid bar stock. The driving gear ratio is approximately 2 to 1. All gears are enclosed in a cast-aluminum case. Lubrication is furnished by the Alemite pressure system. Announced by Errington Mechanical Laboratory, Inc., Staten Island 4, N. Y. 110





Colonial Automatic Broach- and Work-Handling Equipment

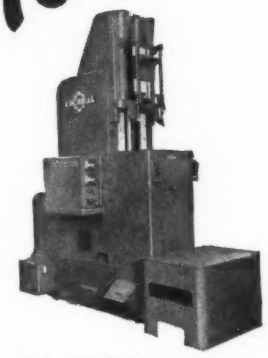
A universal horizontal broaching machine equipped with new automatic broach-handling mechanism and parts-ejector conveyor which is synchronized or interlocked to operate with the machining cycle. This particular machine is equipped for the simultaneous broaching of two universal joint yokes. With the broach-handling mechanism, the operator merely has to place the parts to be broached over the pilot ends of the broaches. Developed by the Colonial Broach Co., Box 37, Harper Station, Detroit 13, Mich. 113

To obtain additional information on equipment described on this page, see lower part of page 228.

When it comes to broaching—

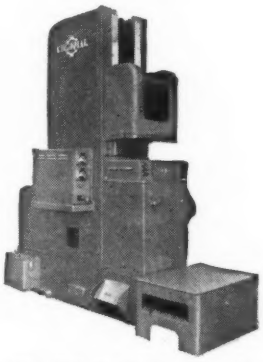
THESE NEW COLONIALS

will cut not only costs and time but "headaches" too



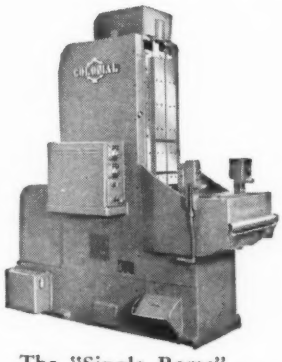
The "Pull-Downs" . . . outstanding for internal broaching of large parts.

Bulletin RD-48



The "Pull-Ups" . . . for fast internal broaching. Automatic unloading for small parts.

Bulletin RU-48



The "Single Rams" . . . there is nothing to equal them* for surface broaching.

Bulletin RS-48

**Except a Colonial "Dual Ram." For shorter runs, the Universal Horizontal is the machine for you.*

Here are some of the "inside" reasons:—

1.

All hydraulic units are grouped externally (cover removed). Valves are so made you can remove them without disturbing or draining the piping.

2.

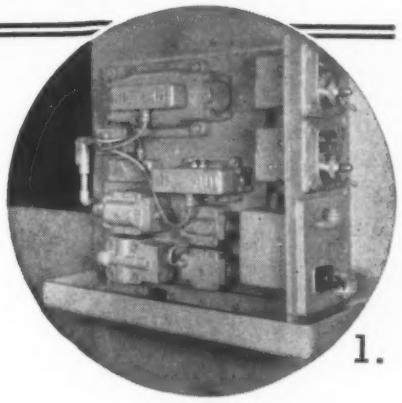
You won't have any trouble tracing circuits on this enclosed electrical panel.

3.

Scientific forced draft cooling of everything inside the machine is one of the reasons for the absence of service difficulties.

4.

It's easy to keep the hydraulic system clean. You can remove, inspect and clean the filters without stopping the machine.



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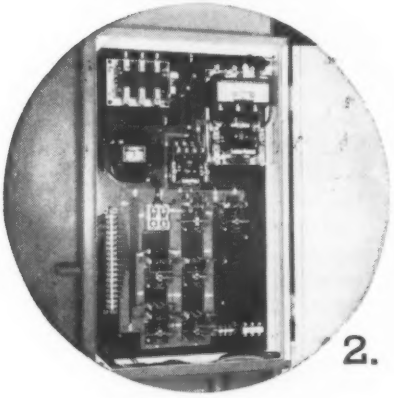

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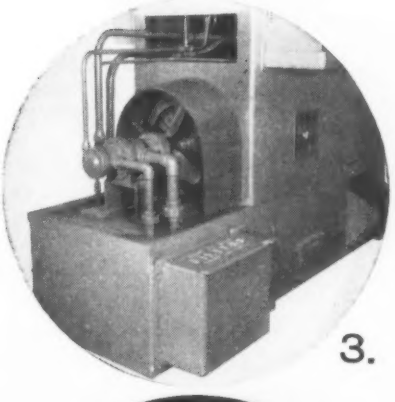

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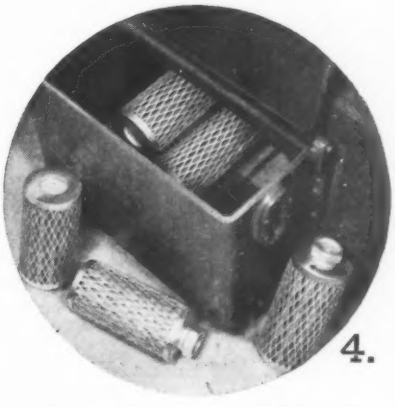


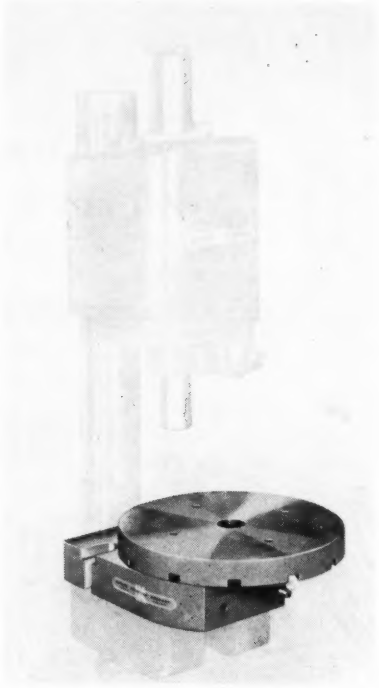
4.

PIONEERS OF H.S.S. BROACHING

COLONIAL

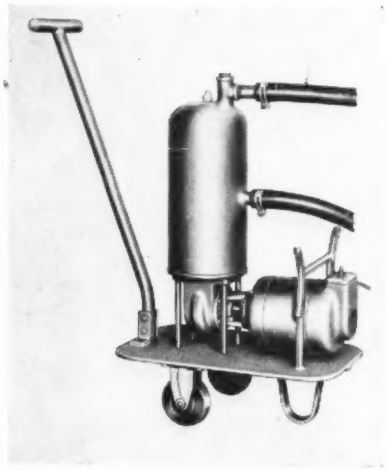
BROACH CO. DETROIT 13

BEST BY TEST



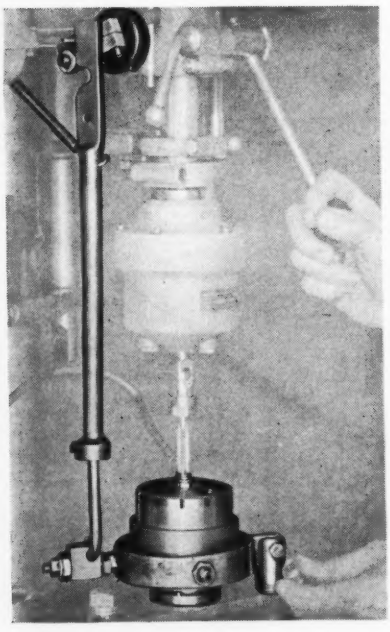
Bryant Air Impact Hammer and Air-Operated Heavy-Duty Indexing Table

The Blank Machine Tool Co., 3105 E. Michigan Ave., Jackson, Mich., has brought out a Model Z-6 air impact hammer of the design shown at the left for widely diversified application in metal-working, plastics, and textile shops. Features include variable power, which can be precisely adjusted from 2800 to 40,000 pounds; hand or foot control of operating speed up to 60 strokes per minute; and facilities for making quick, easy set-ups. Operates on regular 100-pound pressure air line, consuming one cubic foot of air for fifteen strokes. This hammer is adapted for light stamping, small forging work, straightening steel castings, molding, crimping, coining, riveting, piercing, staking, and forming of a variety of materials. The air-operated heavy-duty indexing table shown at the right is another new product of this company. The table is 12 inches in diameter, with a 2-inch thick base, and has twelve stations. It is operated by three-way indexing air valve on 80 to 125 pounds air pressure..114



Ruthman Coolant Pump Unit

New portable pump unit designed for the transfer of liquids and for the rapid removal of coolants from machine tool reservoirs and sumps. This equipment consists of a centrifugal internal-discharge pump unit and a shell type reprime chamber with direct communicating discharge and inlet. The pump is mounted on a fabricated steel truck having large rubber-tired casters. Brought out by the Ruthman Machinery Co., Cincinnati 2, Ohio. 116



Collet Chuck for Drill Press

Goodwin quick-acting collet chuck with simple mechanical linkage that adapts it for attachment to any standard make of drill press to facilitate production drilling and tapping operations. The chuck can be attached in about fifteen minutes. The mechanical linkage connects the drill quill to the chuck collar so that the chuck is automatically closed and locked as the tool approaches the work. Return of the drill press handle releases the work instantly. A spring ejector is available as an accessory. Chucks are made in 1- and 2-inch capacities. Manufactured by the Goodwin Mfg. Co., 10 E. Broadway, Cuyahoga Falls 8, Ohio. 115

Duo Portable Sanding, Grinding, and Drilling Machine

Duo portable electric sander-polisher manufactured by Clarke Sanding Machine Co., Muskegon, Mich. Available with twenty-one accessories which adapt it for grinding, sanding, drilling, buffing, and polishing. This

To obtain additional information on equipment described on this page, see lower part of page 228.

tool can be obtained as a portable sander-polisher only or complete with all accessories. Can be operated on 110-volt alternating or direct current, at free disk speed of 5000 R.P.M. Weight, 4 pounds. 117

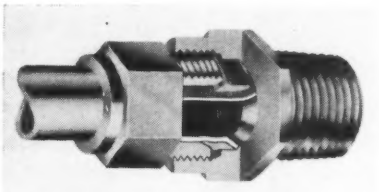
Flame-Machining Process for Sprockets and Gears

The Cogmatic Co., 757 N. Water St., Milwaukee 2, Wis., has announced a rapid, cost-saving method of flame-machining replacements for worn cast-iron or cast-steel sprockets and gears. With the new method, a 12-inch sprocket, for example, can be flame-machined from steel plate in five minutes.

An oxy-acetylene cutting head assembly, mounted on a track operating on a pantograph principle, is moved forward and backward by mechanical linkage in such a manner that the movement transmitted duplicates the contour of one of twenty basic cams, the design of which permits the duplication of standard and special sprockets and gears. The cutting head is fed into the periphery of the revolving steel blank, the turning rate of which is correctly related to the speed of the cutting head....118

Self-Flaring Tube Fitting

Self-flaring leak-proof tube fitting that can be taken apart and reconnected many times without weakening the seal or damaging the flare. The new fitting, called the "Uniflare," has only two parts, and can be easily connected. The thrust collar on the nut part shears off under ordinary wrench tightening force and clamps on the tube, forming a tightly sealed joint. Made in a range of sizes and shapes for use with copper, aluminum, Monel metal, and annealed steel tubing. Made by the Scovill Mfg. Co., Waterbury 91, Conn..119



Speed Reducer of Improved Design

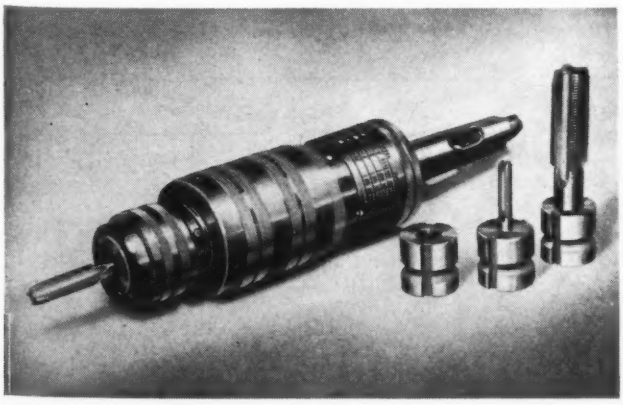
New speed reducer designed to replace TA "Reductor" speed reducer previously marketed by the Boston Gear Works, Quincy 71, Mass. This new "Reductor," known as Type TAN, has heavier gearing, which gives it an increased horsepower rating. The worm is made integral with its shaft to provide ruggedness and reduce the number of parts. Larger shafts permit greater loads, and the one-piece, streamline housing furnishes a greater area for heat radiation. Except for shaft sizes, the new "Reductor" is interchangeable with the present TA unit, having the same mounting dimensions. 120

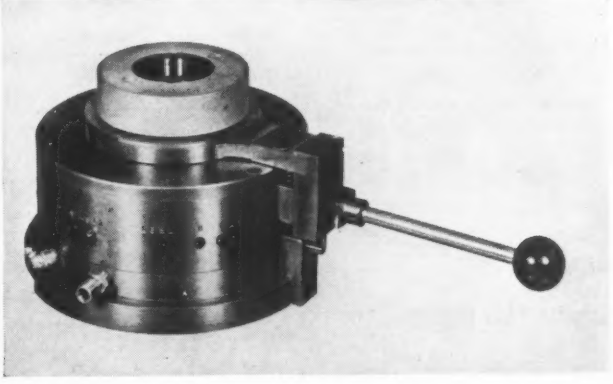
Wickman "Jay-Dee" Tapping Attachment

New type tapping attachment, known as the "Jay-Dee," designed specifically to eliminate tap breakage. This attachment employs a resilient material to provide driving pressures under a safe cutting torque that protects taps, regardless of the load. It can be used with all types of reversible machines for horizontal or vertical tapping of blind or through holes, and is particularly suited for stud driving and for driving standard hand taps. Available in three models with Morse taper shanks in sizes for tapping 1/2-, 3/8-, and 3/16-inch holes. Made by Wickman Mfg. Co., 15533 Woodrow Wilson Ave., Detroit 3, Mich..121

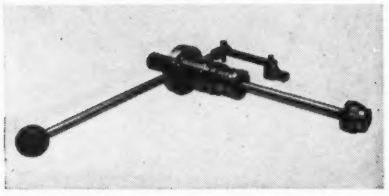
Redmer Index Chuck

Air-operated chuck, 8 3/4 inches in diameter by 5 3/4 inches high, with provision for manual indexing to twelve positions, using a stationary collet designed to give accurate alignment and depth control. The collet has a capacity for holding work from 1/16 inch to 2 inches in diameter. The chuck can be used simply as a holding fixture without indexing, and for various operations such as milling, drilling, and threading. Regularly furnished with standard round collet, two air hose, and Redmer foot control with valve filter regulator and lubricator. Brought out by Redmer Air Devices Corporation, Guntersville, Ala..122





To obtain additional information on equipment described on this page, see lower part of page 228.



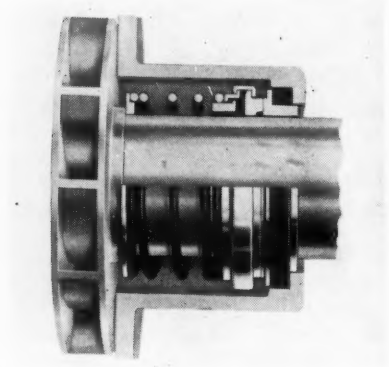
Collet-Closer and Stock-Feeding Attachment

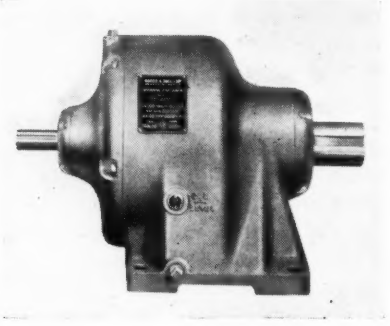
New "Super Ball-Matic Hi-Speed" collet-closer and stock-feeding attachment operating at spindle speeds up to 5000 R.P.M. Brought out by the N. C. Nichols Machine & Engineering Corporation, 1 Sylvan St., Peabody, Mass., to adapt lathes and hand screw machines for semi-automatic operation. Models available in 1/2-, 3/4-, and 1-inch sizes. These attachments will feed stock automatically to accurate lengths, eliminating any pull-back from the stop. 123

Gits Rotating Shaft Seal

Ease of installation is a feature of the rotating shaft seal known as "Roto-Flex," developed by the Gits Brothers Mfg. Co., 1846 Kilbourn Ave., Chicago 23, Ill. This seal is said to prevent leakage of liquids or gases along a rotating shaft when under pressure or vacuum. The seal contains only three main components. The rotating member is held by a compression spring against the fixed surface, or stationary seal.

In addition to the single "Roto-Flex," double units (consisting of two rotating seals mounted on opposite ends of the compression spring) are available. 124



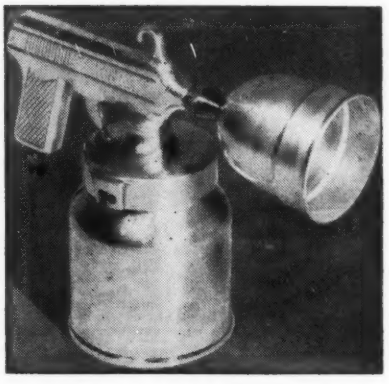


Winsmith Speed Reducer

Helical-gear differential speed reducer produced by the Winfield H. Smith Corporation, Springville, Erie County, N. Y. The advantages of compactness, large number of teeth in action, large speed reduction in a given space, high efficiency, and economy claimed for previous models are retained in the new speed reducer. Additional advantages are direct-centered load distribution, more rigid and vibrationless mounting, larger area for heat radiation, and quieter operation. This gear reducer is designed to operate twenty-four hours daily, if necessary. It is available in ratios of from 5 to 1 to 50,000 to 1 with no increase in the number of parts. Made in six sizes covering a range of 0.62 to 81.5 H.P. Available in horizontal, vertical, and flange-mounted styles. 125

Tornado Sand-Blasting and Solvent-Spray Gun

Tornado combination portable sand-blasting and solvent-spray equipment manufactured by Engineered Products, Inc., 1224 Speer Blvd., Denver, Colo. This air-operated blast gun has been developed to simplify cleaning and finishing operations in the automotive and industrial fields. It leaves no polishing gouge marks, or uneven surfaces, and has no shafts, grinding wheels, or electric motors. The blast gun can be connected to any air line, and is particularly useful for reaching inaccessible places. A case hardened nozzle is furnished for blasting operations, and a "solvent" nozzle for spraying with oils or chemicals. Maximum air consumption is 9 1/2 cubic feet per minute at 100 to 150 pounds per square inch pressure. 126



To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described in this section is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description — or write directly to the manufacturer, mentioning machine as described in December, 1948, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

NAME..... POSITION OR TITLE.....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM.....

BUSINESS ADDRESS.....

CITY..... STATE.....

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 234 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the December, 1948, Number of MACHINERY

Aluminum Alloy Handbook

REYNOLDS METALS CO., 2500 S. Third St., Louisville 1, Ky. Handbook containing 162 pages of data on aluminum alloys and mill products, including physical, chemical and mechanical properties; temper designations; heat-treatment; fabricating methods; tolerances; and other useful information. Copies available without charge to engineers, designers, and technical men who send in a request on their company letterhead to the Reynolds Metals Co.

Drilling and Tapping Machines

NATIONAL AUTOMATIC TOOL CO., INC., Richmond, Ind. Bulletin 748, giving complete engineering data and performance records for the new CA Holesteel single- and multiple-drilling and tapping machines. Copies may be obtained if requested on a compay letterhead, addressed to Dept. 40, National Automatic Tool Co.

Retaining Rings

TRUARC DIVISION, WALDES KOHINOOR, INC., 47-10 Austel Place, Long Island City 1, N. Y. Catalogue containing engineering specifications covering all the standard types of Truarc retaining rings. Requests should be made on company stationery, addressed to Truarc Division, Waldes Kohinoor.

Induction Heating

OHIO CRANKSHAFT CO., TOCCO DIVISION, Department C-14, Cleveland 1, Ohio. Bulletin containing 48 pages of data on induction heating, covering principles, applications, and equipment. Case histories of the use of induction heating for hardening, forging, brazing, and annealing are included. 1

Monel, Nickel, and Inconel Parts

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York 5, N. Y. Catalogue entitled "Standard Specialties," giving application, size, and other data covering about 200 standard products made from Monel, nickel, and Inconel for corrosive and high-temperature service. 2

Non-Ferrous Pressed-Powder Parts

NEW JERSEY ZINC CO., 160 Front St., New York 7, N. Y. Pamphlet entitled "Applications and Properties of Non-Ferrous Powder Parts," presenting technical data and specific case histories on the savings resulting from the use of pressed-powder parts. 3

Flexible Metal Tubing

PENNSYLVANIA FLEXIBLE METALLIC TUBING CO., 72nd St. and Powers Lane, Philadelphia 42, Pa. Bulletin 52-9, giving technical data on "Penflex" interlocked galvanized steel hose and bronze steam hose. Folder entitled "Penflex Flexineering," describing applications of flexible tubing. 4

Anti-Friction Bearings

TYSON BEARING CORPORATION, Massillon, Ohio. Booklet describing the "All Rolls" tapered roller bearing. Manual AFBMA-100, entitled "Anti-Friction Bearing Maintenance," giving instructions for the proper handling and conservation of ball and roller bearings. 5

Turret-Head Metal-Cutters

GRAY MACHINE CO., Box 596, Philadelphia, Pa. Bulletin descriptive of the new Gray turret-head metal-cutter for cutting any shape in sheet metal, including stainless steel and armor plate. Details on the improved design of cutting tool employed on these machines are included. 6

Air-Operated Equipment

MEAD SPECIALTIES CO., Department FT-26, 4114 N. Knox Ave., Chicago 41, Ill. Catalogue describing air-operated cylinders, presses, work-feeders, vises, clamps, etc., including the announcement of a new three-way air valve applicable to any machine for either finger-tip or cam operation. 7

Temperature Control Equipment

CLAUD S. GORDON CO., 3000 S. Wallace St., Chicago 16, Ill. Bulletin announcing two entirely new types of instruments for indicating and recording temperature control in industrial heating processes, known as Xactline-Capacitrol and Xactline-Capacilog.....8

Aluminum Casting Alloys

ALUMINUM ASSOCIATION, 420 Lexington Ave., New York 17, N. Y. "Materials and Methods Manual 35," dealing with aluminum casting alloys, including data on properties, choice of casting methods, design limitations, testing, and processing. 9

Vibration Control Mountings

KORFUND, INC., 48-39-M Thirty-Second Place, Long Island City 1,

How welding simplifies the design of brackets

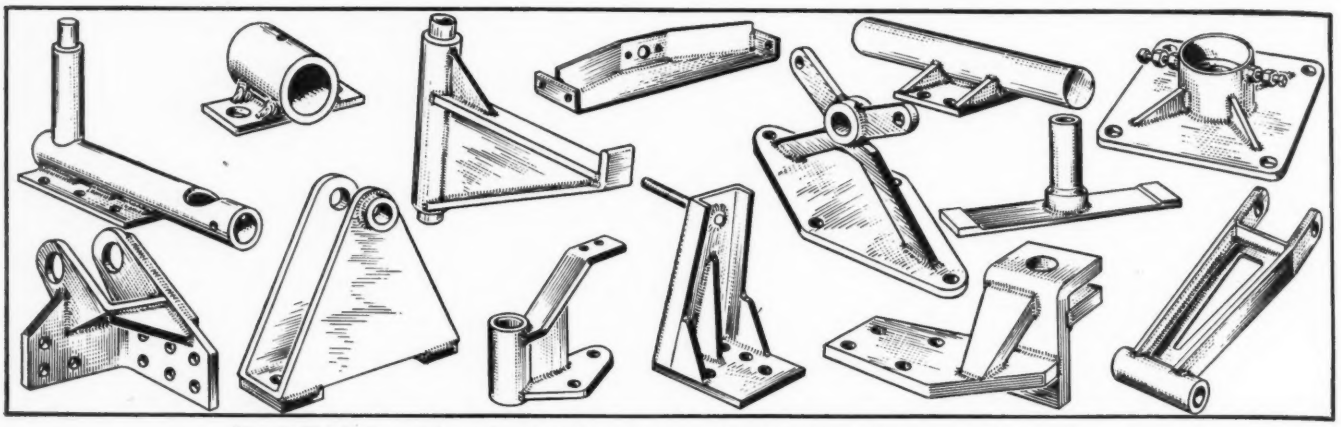


Fig. 1. Typical machinery brackets for various applications *built at lower cost with arc welding.*

WELDING builds all types of component parts, like the brackets shown in Fig. 1 . . . stronger and with less material. Here are several suggestions for building better brackets at lower cost:

Simplest in design are the brackets shown in Fig. 2, made either from separate members or from a single piece sheared and form-bent. For greater rigidity, the cantilever arm can be built from an "I" section (Fig. 3). Two or more of these "I" sections may be placed side by side and butt welded.

Heavy loads are carried with the channel construction shown in Fig. 4. For rigidity and light-weight construction, steel tubing is form-bent and welded to the supporting member (Fig. 5). With tube design, less welding is required.

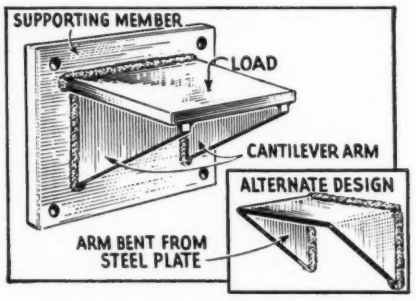


Fig. 2. *Simple bracket design* for normal loading.

Improved product appearance and high product strength are combined by using totally enclosed box-type construction (Fig. 6). Individual parts are fabricated from standard mill shapes or are cut from steel plate.

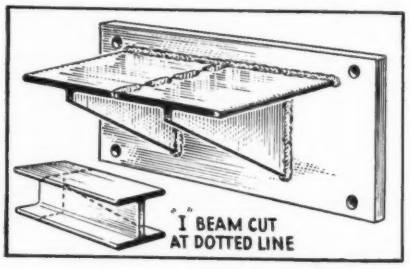


Fig. 3. *Alternate welded design* for low-cost construction. Standard "I" beams are cut and fillet welded to supporting member.

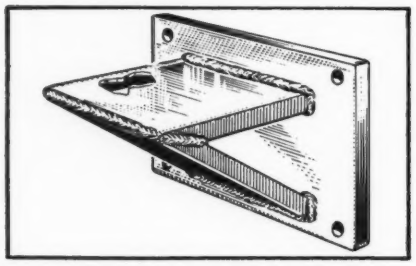


Fig. 4. *For heavy loading,* the cantilever arm is made from channels flame-cut to shape and welded.

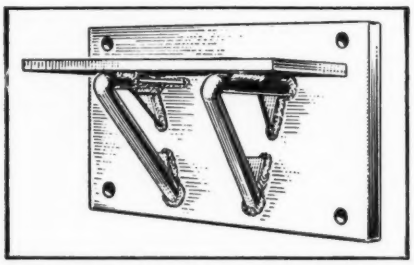


Fig. 5. *Light-weight, rigid construction* uses tubing.

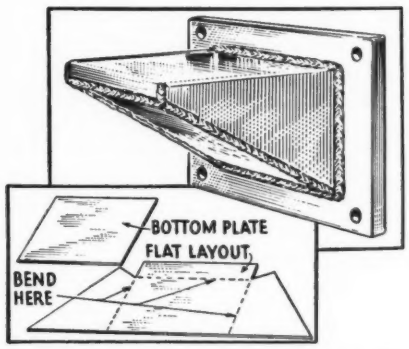


Fig. 6. *Improved product appearance* . . . box-type construction with members sheared, bent to form and welded.

More detailed data on the design of brackets for arc welding is contained in the "Procedure Handbook of Arc Welding Design and Practice." Price $1.50 postpaid in the U. S. A.; elsewhere $2.00.

The above is published by LINCOLN ELECTRIC in the interests of progress. Machine Design Studies available to engineers and designers. Write on your letterhead to The Lincoln Electric Company, Dept. 412, Cleveland 1, Ohio. Advertisement

N. Y. Bulletin G-101, containing data on the installation and uses of various types of vibration control mountings. A selector chart tabulates more than fifty machine and equipment applications. 10

Die-Casting Practice

HYDRAULIC PRESS MFG. CO., Mount Gilead, Ohio. Reprint entitled "Modern Die Casting Practice," containing a discussion of the subject of die-casting, including die-casting methods and machines, dies and die design, and applications. 11

Magnetic Pulleys

DINGS MAGNETIC SEPARATOR CO., 4740 W. McGeogh Ave., Milwaukee 14, Wis. Catalogue C-1001A, on Dings magnetic pulleys and pulley type separators. Catalogue C-1007A, descriptive of Dings non-electric Alnico magnetic "Perma-Pulleys." 12

Automatic Air Valves

PAUL VALVE CORPORATION, 683 Third Ave., New York 17, N. Y. Circular descriptive of air-hose springless and packless automatic air-hose valves designed to produce an unusually powerful air blast for general industrial and chemical use. 13

Welding and Cutting Apparatus

VICTOR EQUIPMENT CO., 844-54 Folsom St., San Francisco 7, Calif. Circular 20B, illustrating and describing the Victor line of gas welding and flame cutting apparatus, including torches, tips, regulators, etc. 14

Steel Tubing

JOSEPH T. RYERSON & SON, INC., Box 8000-A, Chicago 80, Ill. Bulletin containing 32 pages of data on seamless and welded carbon-steel tubing, stainless-steel tubing and pipe, and structural tubing. 15

Universal Speed Reducers

EUCLID MACHINE & TOOL CO., 15002 Woodworth Road, Cleveland 10, Ohio. Catalogue 201, covering the Euclid line of universal speed reducers, giving ratio of reduction, weight and oil capacities of the various sizes.....16

Lathe Turrets

ENCO MFG. CO., 4522-4 Fullerton Ave., Chicago 39, Ill. Catalogue 48, illustrating many typical applications of lathe turrets on actual jobs. Selection charts showing the proper turret for particular lathes are included. 17

Broaching Machines

COLONIAL BROACH CO., Box 37, Harper Station, Detroit 13, Mich. Bulletins RD-48, RU-48, and RS-48, describing the company's improved line of pull-down, pull-up, and single-ram broaching machines, respectively. 18

Hacksaw Blades

VICTOR SAW WORKS, INC., Middletown, N. Y. Leaflet 100-V-3, containing list prices and specifications of Victor hacksaw blades. A table of recommended teeth and speeds for cutting different materials is included. 19

Lift-Trucks

LIFT TRUCKS, INC., 2423-2431 Spring Grove Ave., Cincinnati 14, Ohio. Bulletin K-48, giving specifications on the Hydroelectric line of lift-trucks, as well as instructions on how to select the proper truck for a specific job. 20

Bronze Alloy

AMERICAN NON-GRAN BRONZE CO., Berwyn, Pa. Bulletin containing information on applications, physical characteristics, and structure of Non-Gran bronze. A table of available stock bar sizes is included. 21

Portable Air Tools

BUCKEYE TOOLS CORPORATION, Dayton 1, Ohio. Catalogue containing specifications on the completely redesigned line of Stream-Power portable air tools; includes data on air pressures and tool efficiency. 22

Electric-Arc Stud Welding

NELSON STUD WELDING DIVISION, MORTON GREGORY CORPORATION, Toledo Ave. and E. 28th St., Lorain, Ohio. Operating manual covering the application of Nelson automatic electric-arc stud welding. 23

Silver-Alloy Brazing

HANDY & HARMAN, 82 Fulton St., New York 7, N. Y. Bulletin 17, containing instructions for brazing fittings to pipe and tubing with "Easy-Flo" and "Sil-Fos." 24

Pneumatic Control System

LEEDS & NORTHRUP CO., 4934 Stenton Ave., Philadelphia 44, Pa. Catalogue ND4B, describing L & N Micromax and Speedomax pneumatic controllers and their application in controlling a variety of conditions. 25

Diamond Band-Sawing Machines

DOALL CO., Des Plaines, Ill. Technical report covering the contour-sawing of hard metals and vitreous materials with the newly developed diamond band-sawing machine. 26

Thread-Generating Machine

GEORGE SCHERR CO., INC., 199 Lafayette St., New York 12, N. Y. Folder on the new Cornelis thread-generating machine for cutting screw threads, lead-screws, and worms by an improved generating method. 27

Cabinet-Forming Machines

CYRIL BATH CO., 6955 Machinery Ave., Cleveland 3, Ohio. Catalogue 6700, describing contour forming and bending machines and dies for the manufacture of metal cabinets, cases, housings, etc. 28

Self-Aligning Roller-Bearing Units

SHAFER BEARING CORPORATION, 801 Burlington Ave., Downers Grove, Ill. Bulletin announcing the improved Shafer self-aligning roller-bearing units with new "Microlock" feature. 29

High-Speed Threading Attachment

ETTCO TOOL CO., INC., 592 Johnson Ave., Brooklyn 6, N. Y. Bulletin 22, describing the latest line of Ettco-Emrick high-speed tapping and threading attachment for drill presses. 30

Combination Boring and Reaming Tools

ERICKSON TOOLS DIVISION OF THE ERICKSON STEEL CO., 2309 Hamilton Ave., Cleveland 14, Ohio. Bulletin descriptive of the Erickson-State combination boring and reaming tool. 31

Fixed Gages

THREADWELL TAP & DIE CO., Greenfield, Mass. Catalogue 48G,

containing forty-six pages of reference tables and price lists for Threadwell plug gages, ring gages, snap gages, thread gages, setting disks, etc. 32

Tapping and Threading Machine

WARNER & SWASEY CO., Cleveland 3, Ohio. Bulletin descriptive of the company's No. 11 tapping and threading machine, including complete specifications. 33

Riveting Machines

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago 22, Ill. Bulletin 244, illustrating and describing Hanna pneumatic yoke riveters. Bulletin 246, covering Hanna rapid riveters. 34

Cold-Finished Steel

JONES & LAUGHLIN STEEL CORPORATION, Pittsburgh 30, Pa. Booklet containing information on the physical properties of Jalcase cold-finished free-machining steel and other technical data...35

Milling and Boring Machines

FITCHBURG ENGINEERING CORPORATION, Fitchburg, Mass. Booklet illustrating some of the many types of special-purpose machines designed by the company for a variety of industries. 36

Flexible Metal Coolant Hose

CHICAGO METAL HOSE CORPORATION, Maywood, Ill. Bulletin describing the "Stay-Put" line of flexible metal coolant hose designed especially for conducting coolants on machine tools. 37

Insert-Chaser Die-Heads

EASTERN MACHINE SCREW CORPORATION, 23-43 Barclay St., New Haven 6, Conn. Bulletin 15, descriptive of H & G insert-chaser die-heads for Davenport automatic screw machines. 38

Nickeloid Metals

AMERICAN NICKELOID CO., Peru, Ill. Catalogue entitled "Fiftieth Anniversary of Nickeloid Metals," reviewing the history of the company in the fifty years of its production of pre-plated metals.....39

Grinding and Polishing Machines

STANDARD ELECTRICAL TOOL CO., Cincinnati 4, Ohio. Bulletin 112, containing specifications for Cadet grinders, polishers, and buffers. 40

Blind Rivets

B. F. GOODRICH CO., Akron, Ohio. "Rivnut Data Book," containing information on "Rivnuts," including types, sizes, and grip ranges, as well as test data and installation instructions. 41

Cast-Iron Pulleys

SPROUT-WALDRON & CO., Muncy, Pa. Bulletin P-848, containing specifications, including price lists, covering the "Blue Face" line of cast-iron pulleys. 42

Protective Coatings

UNITED CHROMIUM, INC., 51 E. 42nd St., New York 17, N. Y. Bulletin MC-2, descriptive of the Ucilon line of corrosion-resisting materials for industrial use.....43

Angle Gage-Blocks

WEBBER GAGE CO., 12909 Triskett Road, Cleveland 11, Ohio. Folder describing how angle measurements are simplified by the use of Webber angle gage-blocks...44

Flexible Insulated Couplings

CHARLES BOND CO., 617 Arch St., Philadelphia, Pa. Catalogue F-22, containing information for designers and engineers on flexible insulated couplings. 45

Diamond Dressers

FISH-SCHURMAN CORPORATION, 230 E. 45th St., New York 17, N. Y. Leaflet DT328D, on the new "Steelset" area type diamond dressing and truing tool. 46

Rotary Files

AMERICAN SWISS FILE & TOOL CO., 410 Trumbull St., Elizabeth 1, N. J. Bulletin on rotary files of hand-cut and ground-from-solid types. 47

Screw Slotters

KENT MACHINE CO., Cuyahoga Falls, Ohio. Circular illustrating and describing the new Kent semi-automatic screw slotter...48

Speed Reducers

JANETTE MFG. CO., 556 W. Monroe St., Chicago 6, Ill. Bulletin 10-10, describing Janette Gearmotors and speed reducers. 49

Keyway Broaches

DU MONT CORPORATION, Greenfield, Mass. Folder containing condensed data on "Minute Man" keyway broaches and sets. 50

To Obtain Copies of New Trade Literature

listed in this section (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue (December, 1948) to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

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By E.S.S.

BETWEEN GRINDS

Mixed Greetings

We wish you readers of MACHINERY a traditional Merry Christmas replete with all the et ceteras that make your holiday individually a gay one. And, overflowing with this seasonal spirit, we wish ourselves a happy anniversary—for although no one sent us a horseshoe of flowers to commemorate the occasion, we of Between Grinds are one year old this very month.

Jammed in a Desk Drawer

A book order form nineteen years old arrived the other day from a Chicagoan, ordering a book we publish on gages. Probably the only coupon he received in 1929, it was tucked away for safe keeping.

Lend a Foot Here

You are standing outside a church on a Sunday morning in a line of nineteen men all with their left feet touching heel to toe. Why? Because back in the Sixteenth Century, where you are momentarily, someone needed a rod's length and that is how it was measured.

If you were an ancient Greek schoolboy you probably did your homework in spans, palms, digits, and cubits. A cubit, by the way, is the length of the forearm from your elbow point to the end of your middle finger. All this and more (we're not one to tell everything we know) was culled from a leaflet on the historical review of the measurement of length issued by the Ford Motor Co.

A New Word, A New Method

Del S. Harder and Mead Bricker, vice-presidents of the Ford Motor Co., sat in a meeting with some of their top production men. Mr. Bricker asked for means of handling parts in process of manufacture, without the delays often incurred due to the human element.

"That's right, 'Brick,' what we need is more Automation," remarked Mr. Harder.

No time was lost by the engineering department in applying "automation" to the assembly line. And the leading article in January MACHINERY brings you the story of Ford's progress in launching their brand new idea at the Highland Park plant.

More, Please!

From Greensboro, N. C., Mr. J. S. Longdon writes: "Have just attended a sales school held by Federal Products Corporation, where they presented me with a set of folders entitled 'The Sales Engineer and His Problems' by Mr. Bernard Lester. These are so amazingly written that I would like to have ten sets if they are available, and I'll be happy to pay any reasonable amount for them." Since we send out 3798 (and up —the two words that usually spoil budgets) reprints of each month's article, in quantities from 2 to 200, to companies and individuals who have requested them, it was routine for us to oblige Mr. Longdon.

CONTRIBUTOR WITH HOE . . . When John J. McNeff arrived in New England from Ireland he heard talk about a draftsman. "Draught" applied only to horses and beer, so he investigated this phenomenon, and then decided to become one (draftsman, that is). Behind a drawing board at the Brown & Sharpe Mfg. Co. in Providence, he designed cams and special tools through World War I. War over, Mr. McNeff decided for farming in the west and with his family settled in western Texas. But the "old devil" drafting board beckoned again and he ran up a shingle for the benefit of the oil field men in the vicinity who had ideas and patents on equipment. With the approach of World War II he marched into the plant of North American Aviation at Grand Prairie as a Class A tool designer. Now he is with the Victor Cam Co. of Irving, Texas. Despite the expansive cornfield in the adjacent picture, Mr. McNeff leaves those wide open spaces to the native Texans and cultivates a small garden patch reminiscent of New England and Ireland for his recreation. By turning to page 191, you may see how Mr. McNeff handles his article on a sawing attachment.

News of the Industry

California and Oregon

RAYBESTOS-MANHATTAN, INC., Passaic, N. J., announces the opening of a new warehouse and office at 4651 Pacific Blvd., Los Angeles 11, Calif., to service and stock rubber goods and packings for industrial and oilfield requirements in southern California. SCHUYLER V. V. HOFFMAN will be in charge.

ALDEN G. ROACH, formerly president of Consolidated Western Steel Corporation, has been appointed president of Columbia Steel Co., San Francisco, Calif., the steel-producing subsidiary of United States Steel Corporation on the Pacific Coast. He succeeds J. LESTER PERRY, who will continue to serve the corporation in an advisory capacity.

AMERICAN BRASS & COPPER CO., Oakland, Calif., has been appointed distributor of the aluminum products made by the REYNOLDS METALS CO., Louisville, Ky. WESTERN METALS & SUPPLY CO., San Diego, Calif., has also been made a distributor.

THOMAS B. MOULE, assistant director of sales of the Plomb Tool Co., Los Angeles 54, Calif., has been appointed sales manager of the company. For five years following his graduation from the University of Michigan, Mr. Moule was advertising and sales promotion manager for Ex-Cell-O Corporation, Detroit, Mich., and more recently has been sales manager of the Republic and the Northern Aircraft Products Divisions of the Aviation Corporation.

Thomas B. Moule, Recently Appointed Sales Manager of the Plomb Tool Co.

CERRO DE PASCO COPPER CORPORATION, New York City, has appointed PECK STEEL AND DIE SUPPLY, 4436 Long Beach Ave., Los Angeles 11, Calif., distributor of Cerro low-temperature melting alloys.

A. H. DILL has been made western district manager for the A. B. Farquhar Co., York, Pa., manufacturer of farm equipment, conveyors, hydraulic presses, etc. His headquarters will be at 720 Magnolia St., Menlo Park, Calif.

DETREX CORPORATION, manufacturer of degreasing solvents and cleaning compounds, announces the removal of its Los Angeles office and warehouse to 625 S. Anderson St., Los Angeles 23, Calif.

RONALD A. JOHNSON has been appointed assistant to PAUL BRAINARD, head of the newly created engineering and standards department of the Hyster Co., Portland, Ore., manufacturer of industrial trucks and tractor tools.

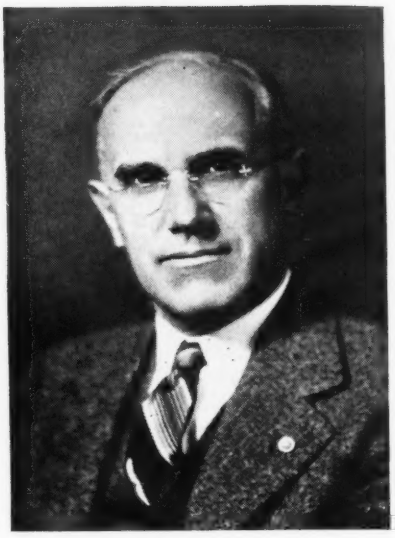
Illinois

WHITING CORPORATION, Harvey, Ill., recently announced that G. E. SEAVOY, vice-president in charge of the Process Sales Division, will direct all field sales operations, including advertising, field erection, and service; and M. J. RICE, vice-president in charge of the Industrial Sales Division, will direct all of the company's product sales divisions.

WILLIAM J. MCGRAW has been appointed manager of the Cleveland branch of the Independent Pneumatic Tool Co., Aurora, Ill. Mr. McGraw, formerly manager of electric tool sales in the New York territory, will be succeeded in that capacity by ED B. ROSELL, who has been transferred from the Chicago branch, where he served as electric tool service engineer.

E. E. BRADBERRY has been appointed assistant manager of sales in Chicago by the Jessop Steel Co., Washington, Pa. His offices are at 322 S. Michigan Ave. Mr. Bradberry was formerly stainless steel sales engineer in the Chicago office of the Carnegie-Illinois Steel Corporation.

D. A. HUTCHISON has been named general sales manager of the Sterling Tool Products Co., Chicago, Ill., manufacturer of portable sanding machines, succeeding J. A. PROVEN. Mr. Hutchison was previously assistant sales manager.



George N. Sieger, Newly Elected President of the American Welding Society

Michigan

GEORGE N. SIEGER, president of the S-M-S Corporation, Detroit, Mich., has been elected president of the American Welding Society for the year 1948-49. Mr. Sieger is a national authority on resistance welding, and is a past president of the Resistance Welder Manufacturers Association.

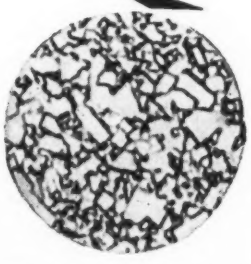
B. O'MEARA, sales manager of the Gairing Tool Co., Detroit 32, Mich., has been promoted to the position of vice-president. Mr. O'Meara, who

B. O'Meara, Recently Elected Vice-president of the Gairing Tool Co.

Better Performance ... because of Better Structure*

This Kennametal Style 11H90 Tool turns five of these semi-steel cast-iron cylinder liners compared to one with the carbide tool formerly used

It takes a hard, strong, sound tool material to remove 4,500 cubic inches of metal from five of these semi-steel cast-iron cylinder liners before regrinding—and then to repeat the performance after each resharpening, over the entire life of the tool.



* Consistent soundness and uniformity of structure characterize all Kennametal compositions, as illustrated in the micrograph above (1500 times enlargement). Note absence of large grains, and virtual freedom from porosity.

All Kennametal compositions are much harder than the hardest tool steel, and the uniformity of hardness and strength of each grade comes from a consistently sound physical structure which is produced by distinctive processing, and precise, scientific methods of control.

The proof of the pudding is in the eating—service results prove that a carbide which gives superior service is that having uniform grain structure, and therefore consistently maintained hardness, strength, and wear-resistance. That's Kennametal.

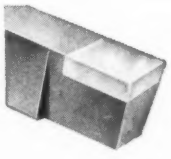
Equally important in cutting machining costs are Kennametal developments in mechanically-held tooling which further extend the profitable use and low-cost maintenance of carbide tooling.

Kennametal tooling is completely-proved—can save money on 90% of your routine and unusual jobs. Ask our district engineer to demonstrate.

KENNAMETAL Inc.
LATROBE, PA.

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTION

STYLE BL


STYLE C

STYLE FL

STYLE GL

KENNAMATIC STYLE 12SK

SERRATED MILLING CUTTER BLADES

nas been associated with the company for over twenty-five years in a sales capacity and who has been on the board of directors for a number of years, will continue to handle sales and advertising for the company.

JAMES R. LONGWELL, for the last four years director of engineering and research of the Carboloy Company, Inc., Detroit, Mich., has been named assistant to the president, and F. C. RITNER has been appointed vice-president in charge of engineering and research. Mr. Longwell joined the Carboloy organization nineteen years ago, and has served successively as development engineer, chief engineer, factory manager, and director of engineering and research. Mr. Ritner has also been with the company since 1929, and has been active, not only in engineering, but also in sales, service, and industrial relations capacities.

VIKING PRODUCTS CO., INC., 2373 E. Eight Mile Road, Detroit, Mich., has recently been organized to produce automatic air valves to be known as "Ring-Seal." Equipment has been installed for mass production of the new line at a plant in Vicksburg, Mich. C. F. LEATHERS is general manager of the concern, and WILLIAM R. ALLEN sales manager.

MICHIGAN ABRASIVE CO., Detroit, Mich., recently moved its complete fabricating facilities and general offices into two new buildings at 2360 W. Jefferson Ave., which afford 30,000 square feet of increased floor space. Manufacturing operations will be continued in the company's old plant at 1111 Bellevue Ave.

Stanford P. Bruce, Head of the "Diamond-Miser" Division of the Wheel Trueing Tool Co.

STANFORD P. BRUCE has been placed in charge of the newly created "Diamond-Miser" Division of the Wheel Trueing Tool Co., Detroit, Mich. Mr. Bruce is the inventor of the "Diamond-Miser"—a mechanical device for predetermining, either automatically or manually, the degree of rotation of wheel-dressing diamond tools—which is being manufactured by the Wheel Trueing Tool Co.

New England

E. J. FULLAM, president of the Fellows Gear Shaper Co., Springfield, Vt., resigned his position at a recent meeting of the board of directors and was elected chairman of the board. E. W. MILLER was elected president of the company; R. M. FELLOWS, first vice-president and treasurer; C. M. PETER, vice-president and general manager; and H. T. GATES, vice-president and factory manager. The day before Mr. Miller's election as president, he was given a dinner to celebrate the rounding out of fifty years of service with the company. The board of directors and their wives, together with the heads of the various departments, were present. The highlight of the evening was the presentation by Mr. Fullam to Mr. Miller of a fifty-year service pin and a morocco-bound commemoratory book containing an outline of his activities and congratulatory messages from his co-workers, as well as from his many other friends, both in this country and abroad.

JOHN C. KUHN, sales manager of the Morse Twist Drill & Machine Co., New Bedford, Mass., a division of Van Norman Co., Springfield, Mass., has been advanced to the position of vice-president and director of sales. At the same time, A. L. CARR has been promoted from assistant sales manager to sales manager of the company. STANLEY B. LINDH has been named to the newly created post of sales promotion manager.

J. CLIFFORD BERTHIAUME has been appointed district manager for the central western territory by the Nicholson File Co., Providence, R. I. He has been connected with the company since 1936, previously serving as sales representative with headquarters in Minneapolis.

PRATT & WHITNEY DIVISION, NILES-BEMENT-POND CO., West Hartford 1, Conn., has announced that JAMES D. ALLAN, manager of the Cleveland office, has been transferred to West Hartford and appointed manager of domestic machine tool sales. FRANK W. SCHREINER has been promoted to the post of Cleveland sales manager. He has been a member of the Cleveland sales staff for twenty-one years. Mr. Allan has been with the company since 1923, and has been connected with the Cleveland machine tool sales staff since 1925.

FENN MFG. CO., Hartford, Conn., announces that it has recently acquired the main line of machines manufactured by the STANDARD MACHINERY CO., Providence, R. I., consisting of metal-rolling mills, punch presses, swaging machines, Turk heads, and special large-diameter bearings. Operations will continue temporarily at the Providence plant, but it is planned eventually to move the newly acquired line to the Hartford and New Britain plants of the company.

E. J. Fullam, Chairman of the Board of the Fellows Gear Shaper Co., Presenting a Commemoratory Book to E. W. Miller, the New President, in Honor of His Fifty Years of Service with the Company

EX-CELL-O

CAN GIVE YOU MORE ECONOMICAL PRODUCTION

For Instance,

On Applications of Modern Thread Grinding:

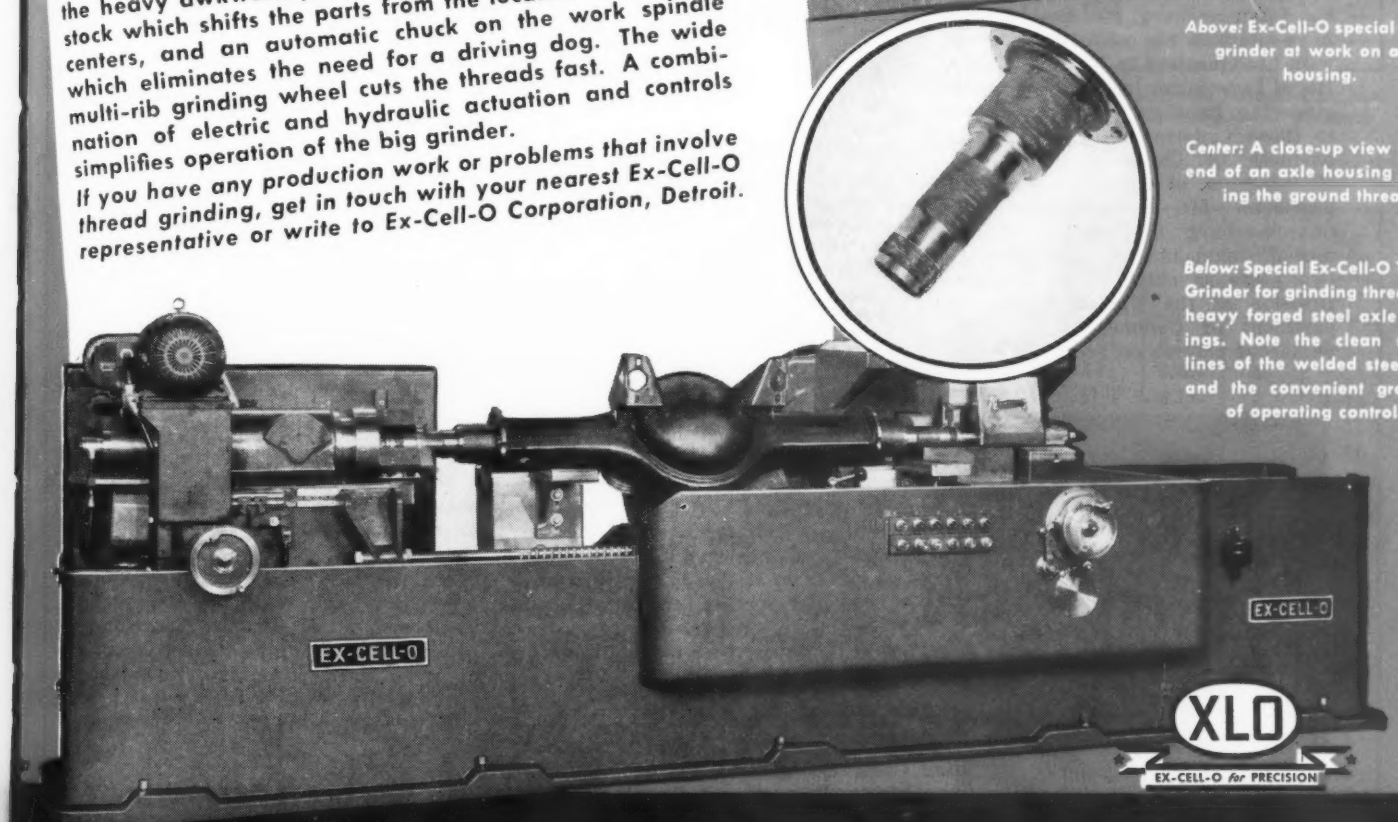
The special Ex-Cell-O machine illustrated here grinds threads on large tough axle housings for some of the heaviest trucks and busses that travel the highways. The housings are made of forged steel hardened to approximately 40-C Rockwell. Special tooling on this production machine includes approximate locators to aid in handling the heavy awkward parts, a hydraulically actuated tail-stock which shifts the parts from the locators to the work centers, and an automatic chuck on the work spindle which eliminates the need for a driving dog. The wide multi-rib grinding wheel cuts the threads fast. A combination of electric and hydraulic actuation and controls simplifies operation of the big grinder.

If you have any production work or problems that involve thread grinding, get in touch with your nearest Ex-Cell-O representative or write to Ex-Cell-O Corporation, Detroit.

Above: Ex-Cell-O special thread grinder at work on axle housing.

Center: A close-up view of one end of an axle housing showing the ground thread.

Below: Special Ex-Cell-O Thread Grinder for grinding threads on heavy forged steel axle housings. Note the clean simple lines of the welded steel base and the convenient grouping of operating controls.



XLO
EX-CELL-O *for* PRECISION

EX-CELL-O CORPORATION

Detroit 32, Michigan

Special Multiple Way-Type Precision Boring Machines • Special Multiple Precision Drilling Machines • Precision Boring, Turning, and Facing Machines and Fixtures
Precision Cylinder Boring Machines • Precision Thread Grinding Machines • Precision Lapping Machines • Precision Broach Sharpening Machines
Other Special Purpose Machines • Tool Grinders • Continental Cutting Tools • Broaches and Broach Fixtures • Counterbore Sets • Grinding Spindles
Hydraulic Power Units • Drill Jig Bushings • R.R. Pins and Bushings • Fuel Injection Equipment • Dairy Equipment • Aircraft and Miscellaneous Production Parts

TORRINGTON CO., Torrington, Conn., announces the following changes in personnel: RICHARD C. LAWTON has been appointed district engineer in western New York State for the Bearings Division, with headquarters in Rochester; J. H. WILLIAMS has been made assistant to L. A. TOTH, who has been appointed district manager of the Dallas office; and J. N. WHOLEAN has been added to the Milwaukee staff.

GEOMETRIC TOOL CO., New Haven, 15, Conn., manufacturer of machines and tools for cutting screw threads, announces the appointment of the WRIGHT INDUSTRIAL SUPPLY CO., 3630 Detroit Ave., Toledo 12, Ohio, as distributor in northwestern Ohio.

New York and New Jersey

DAMPNEY CO. OF AMERICA, Boston, Mass., has appointed the R. J. DENTON CO., Syracuse, N. Y., distributor for Apexior and Thur-Ma-Lox protective castings.

HERMAN C. PHELPS has been made sales manager of the All-State Welding Alloys Co., White Plains, N. Y.

R. E. W. HARRISON, vice-president of the Chambersburg Engineering Co., Chambersburg, Pa., has resigned to re-establish his consulting service, with headquarters in New York City. He will specialize in management engineering, handling problems similar to those undertaken by the former business of Clarke-Harrison, Inc., Philadelphia, of which he was vice-president. Mr. Harrison joined the Chambersburg Engineering Co. as vice-president in 1935, after serving two years as chief of the Machine Division of the United States Department of Commerce. He holds numerous patents on precision grinding machinery, and has made notable contributions to other metal-working techniques, including drop-forging.

R. E. W. Harrison, Head of a New Management-Engineering Consulting Service

J. T. GILLESPIE, JR., has been appointed sales manager of the Watson-Stillman Co., Roselle, N. J. Mr. Gillespie joined the company in 1944 as director of export sales, in which capacity he remained until his present appointment. In his new position, he will continue to supervise the company's export sales.

Ohio and Kentucky

CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio, is erecting a new manufacturing plant for the Cimcool Cutting Fluid Division of the company. This modern, self-contained plant will include its own purchasing department, chemical laboratories, and shipping and receiving facilities. The latest equipment will be installed for making cutting fluids. The one-story building is to be constructed of steel, brick, glass block, and insulated aluminum panels. Careful attention has been given to providing the best possible working conditions, with adequate light.

PROGRESSIVE WELDER SALES CO., 5713 Euclid Ave., Cleveland, Ohio, has recently been organized by ERNEST H. LAUTER and GEORGE OMELIANOFF to handle the sales of resistance welding equipment in eastern Ohio, western Maryland, western Pennsylvania, and the northern section of West Virginia. For the last fifteen years, Mr. Lauter has acted as representative for prominent welding machine manufacturers. Mr. Omelianoff was associated with the Progressive Welder Co. as an applications engineer for five years.

WARNER & SWASEY CO., Cleveland 3, Ohio, has received one of five product design awards presented annually by the magazine *Electrical Manufacturing* for its new 1-AC electrically controlled, single-spindle automatic chucking machine. This machine was introduced at the Machine Tool Show last fall. The company presented the $500 cash award which accompanied the citation to RALPH H. SCHUMAN, designing electrical engineer, who wrote the paper describing the machine.

U. S. MACHINE TOOL CO., DIVISION OF N. RANSOHOFF, INC., Cincinnati, Ohio, has acquired the BURKE MACHINE TOOL CO., of Conneaut, Ohio, and formed the U. S.-BURKE MACHINE TOOL CO. The new company, located at 16 E. 72nd St., Cincinnati 16, Ohio, will manufacture bench and floor type milling machines. The officers are S. CHARLES STRAUS, president; R. C. WIGGER, vice-president; and JOHN R. STRAUSS, secretary-treasurer.

BOYE & EMMES MACHINE TOOL CO., Cincinnati, Ohio, manufacturer of engine lathes, announces the appointment of the FRANK A. MEYER CO., 401 N. Broad St., Philadelphia, Pa., as exclusive sales representative in eastern Pennsylvania, southern New Jersey, and Delaware. The company has also appointed BARRY & SON CO., 406 W. Franklin St., Baltimore, Md., representative in Maryland.

MONARCH MACHINE TOOL CO., Sidney, Ohio, announces the establishment of a Cincinnati sales office in the Roselawn Center Bldg. FRANK HEAP, formerly at Indianapolis, will head the expanded Cincinnati-Indianapolis sales territory, while DON POTTER, previously assistant to Mr. Heap, will assume charge of the Indianapolis office.

WHEEL TRUEING TOOL CO., Detroit 6, Mich., announces the appointment of ARTHUR J. BAEHR as representative in the Pittsburgh area. Mr. Baehr represents the company in the Cleveland area also. His headquarters are at Chagrin Falls, Ohio.

MOTCH & MERRYWEATHER MACHINERY CO., 1213 W. Third St., Cleveland, Ohio, has been appointed distributor for Walker vertical surface grinders in Cleveland, Detroit, Pittsburgh, Cincinnati, and Dayton.

RALPH W. MORRISON has been appointed general sales manager of the Aro Equipment Corporation, Bryan, Ohio, manufacturer of pneumatic tools, lubricating equipment, and aircraft products.

G. B. DAVIS has been promoted from assistant sales manager to sales manager of the Baker-Raulang Co., 2168 W. 25th St., Cleveland, Ohio, manufacturer of industrial trucks, tractors, and cranes.

LIN C. COOK has been appointed chief industrial engineer for Willys-Overland Motors, Toledo 1, Ohio.

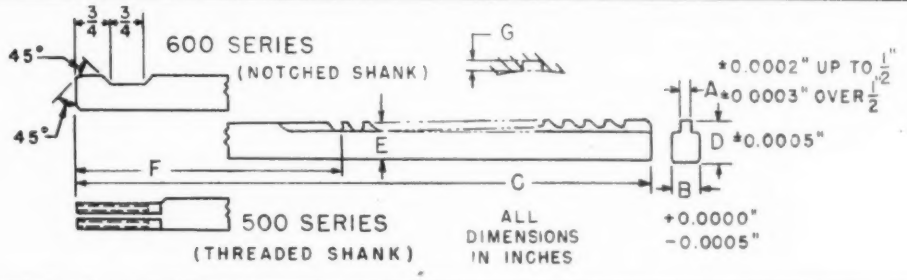
GEORGE R. MILNE has been appointed operating manager of the National Carbide Corporation, 60 East 42nd St., New York 17, N. Y. He was previously works manager at the Louisville, Ky., plant of the company, and will continue to have his headquarters at that plant. RUSSELL T. LUND, former plant superintendent at Louisville, has been made assistant operating manager.

Pennsylvania

JESSOP STEEL CO., Washington, Pa., announces the appointment of the following supervisors: CARL J. MURRAY, general superintendent; EDWARD J. SHERRILL, superintendent of production scheduling and shipping; ELLSWORTH E. SEITZ, director of per-

MACHINERY'S DATA SHEETS 623 and 624

STANDARD KEYWAY BROACHES—1



500 Series Cutter No.	600 Series Cutter No.	A Nom. Dimen.	A Decimal Dimen.	Min. Hole Size	Min. Length Cut	Max. Length Cut	B	C	D	E	F	G	Number of Cuts	500 Series Thread Size
501	601	1/16	0.0635	3/8	3/8	1 1/4	0.1552	20	0.313	0.271	7 13/16	0.042	1	1/4–20
502	602	3/32	0.0948	7/16	1/2	1 1/2	0.1865	24	0.367	0.309	8 1/4	0.058	1	5/16–18
503	603	3/32	0.0948	3/8	3/8	2 1/2	0.249	33	0.491	0.433	10	0.058	1	3/8–16
504	604	1/8	0.126	1/2	1/2	1 1/2	0.249	30	0.438	0.364	9	0.074	1	3/8–16
505	605	1/8	0.126	7/8	5/8	2 1/2	0.3115	36	0.594	0.520	10	0.074	1	1/2–13
506	606	5/32	0.1572	13/32	1/2	1 1/2	0.249	30	0.525	0.436	9	0.089	1	3/8–16
507	607	5/32	0.1572	33/32	5/8	2 1/2	0.3115	33	0.625	0.536	10	0.089	1	1/2–13
508	608	3/16	0.1885	1 1/16	5/8	2 1/2	0.374	36	0.581	0.476	10	0.105	1	1/2–13
509	609	3/16	0.1885	15/16	1 1/16	3 1/2	0.374	36	0.796	0.691	10 11/16	0.105	1	1/2–13
510	610	7/32	0.2198	1 1/16	5/8	2 1/2	0.374	33	0.557	0.437	10	0.120	1	1/2–13
511	611	7/32	0.2198	15/16	1 1/16	3 1/2	0.374	42	0.813	0.693	11 7/16	0.120	1	1/2–13
512	612	1/4	0.251	1 1/16	5/8	2 1/2	0.374	36	0.612	0.476	10	0.136	1	1/2–13
513	613	1/4	0.251	1	1 1/16	4	0.499	45	0.877	0.741	11 13/16	0.136	1	5/8–11
514	614	1/4	0.251	1 7/16	7/8	6	0.624	51	1.250	1.114	13 1/2	0.136	1	3/4–10

MACHINERY'S Data Sheet No. 623, December, 1948

Standards Adopted by the Broaching Tool Institute

STANDARD KEYWAY BROACHES—2

500 Series Cutter No.	600 Series Cutter No.	A Nom. Dimen.	A Decimal Dimen.	Min. Hole Size	Min. Length Cut	Max. Length Cut	B	C	D	E	F	G	Number of Cuts	500 Series Thread Size
515	615	9/32	0.2828	7/8	1 1/16	4	0.499	42	0.716	0.564	11 5/8	0.152	1	5/8–11
516	616	9/32	0.2828	1 1/8	7/8	6	0.499	51	1.093	0.941	13 1/2	0.152	1	5/8–11
517	617	5/16	0.314	1	1 1/16	4	0.499	45	0.908	0.741	11 13/16	0.167	1	5/8–11
518	618	5/16	0.314	1 5/16	7/8	6	0.499	51	1.158	0.991	13 1/2	0.167	1	5/8–11
519	619	3/8	0.3765	1 1/16	1 1/16	4	0.499	45	0.938	0.739	11 13/16	0.199	1	5/8–11
520	620	3/8	0.3765	1 5/16	7/8	6	0.499	54	1.189	0.990	13 1/2	0.199	1	5/8–11
521	621	7/16	0.439	1 9/16	1 1/16	4	0.624	48	1.390	1.160	12	0.230	1	3/4–10
522	622	7/16	0.439	2	1	8	0.624	48	1.611	1.496	15 5/8	0.230	2	3/4–10
523	623	1/2	0.5015	1 1/2	1 1/16	4	0.624	48	1.312	1.051	12	0.261	1	3/4–10
524	624	1/2	0.5015	1 1/2	1	8	0.624	48	1.377	1.246	16 1/2	0.261	2	3/4–10
525	625	9/16	0.5645	1 3/4	1 1/16	4	0.6865	54	1.438	1.146	11 13/16	0.292	1	1–8
526	626	9/16	0.5645	1 5/8	1	8	0.6865	51	1.391	1.245	16	0.292	2	1–8
527	627	9/16	0.5645	2 1/2	1 1/8	12	0.874	60	1.641	1.495	20	0.292	2	1–8
528	628	5/8	0.627	1 7/8	1 1/16	4	0.749	60	1.625	1.301	12 3/16	0.324	1	1–8
529	629	5/8	0.627	2 1/2	1	8	0.874	54	1.657	1.495	16 5/8	0.324	2	1–8
530	630	5/8	0.627	2 1/2	1 1/8	12	0.874	57	1.657	1.495	20	0.324	2	1–8
531	631	3/4	0.752	1 7/8	1 1/16	4	0.874	60	1.625	1.239	12 3/16	0.386	1	1–8
532	632	3/4	0.752	2	1	8	0.999	60	1.688	1.495	16 1/2	0.386	2	1 1/4–7
533	633	3/4	0.752	2 1/2	1 1/8	12	0.999	57	1.688	1.560	20	0.386	3	1 1/4–7
534	634	7/8	0.877	2 1/2	1 1/16	4	1.124	63	1.875	1.426	12 3/8	0.449	1	1 1/4–7
535	635	7/8	0.877	2 1/2	1	8	1.124	63	1.719	1.494	15 1/4	0.449	2	1 1/4–7
536	636	7/8	0.877	2 1/2	1 1/8	12	1.124	63	1.719	1.569	20	0.449	3	1 1/4–7
537	637	1	1.002	2 1/2	5/8	2 1/2	1.249	63	1.750	1.239	10 1/2	0.511	1	1 1/2–6
538	638	1	1.002	2 1/2	7/8	6	1.249	63	1.750	1.494	14 1/4	0.511	2	1 1/2–6
539	639	1	1.002	2 1/2	1 1/8	12	1.249	60	1.750	1.580	20	0.511	3	1 1/2–6

MACHINERY'S Data Sheet No. 624, December, 1948

Standards Adopted by the Broaching Tool Institute

780 PARTS PER HOUR

PART
Actual Size

Broaching STAMPINGS

INCREASES PRODUCTION AND IMPROVES FINISH

TOOLING:

The illustration at the top shows the tooling which Detroit Broach designed and built to broach the slot in this stamping. The operator loads the stamping at the front of the fixture. As the part is indexed around to broaching position, it is automatically clamped. Because the part is open and thin, the broach is returned through the part to starting position after broaching. The fixture then indexes again and the part is automatically ejected.

MACHINE:
Push Type Hydraulic Press

STOCK REMOVED:
1/32" Per Side

MATERIAL:
C.R.S. Stamping

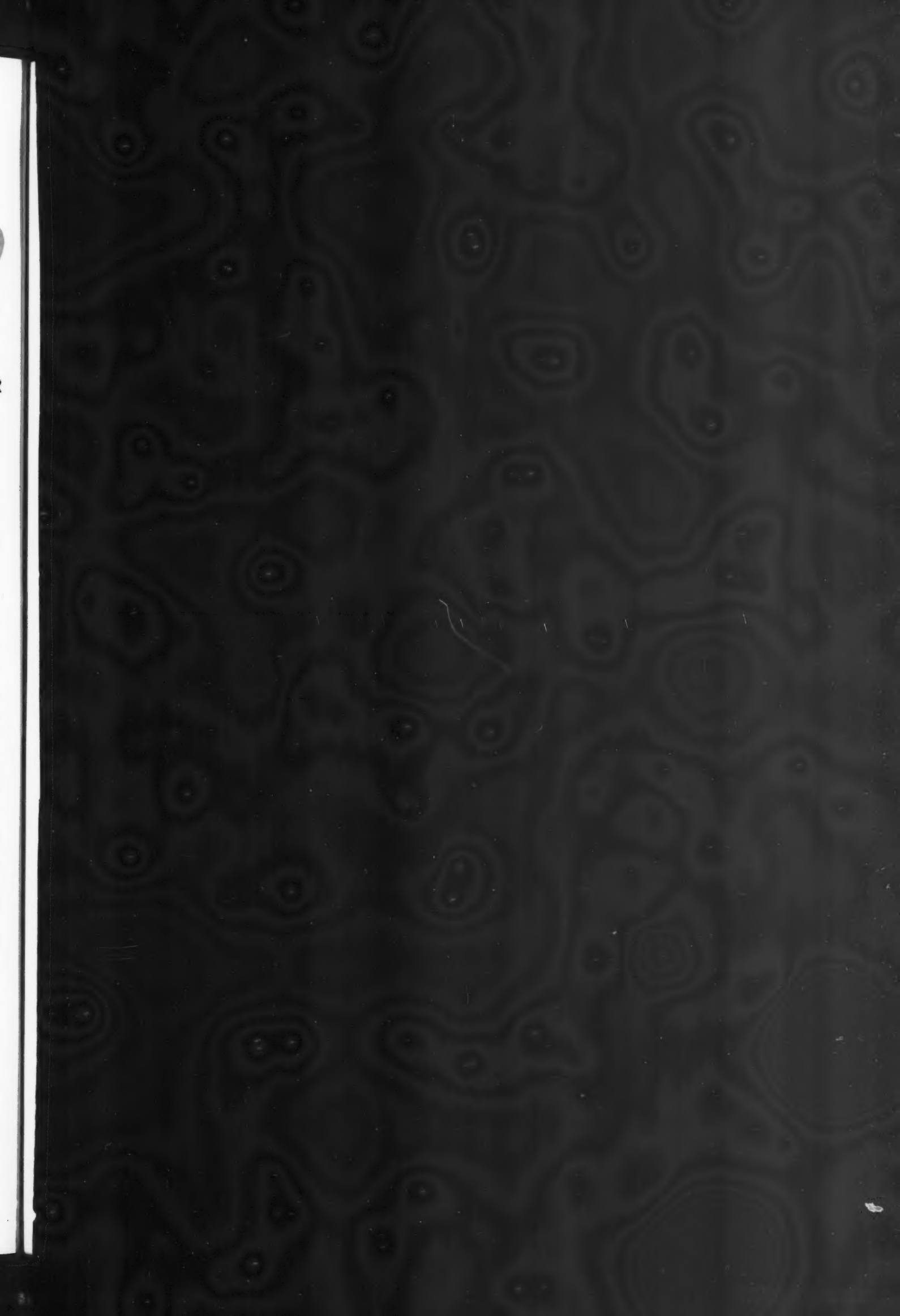
ALTERNATE METHOD:
Hobbing

With one broach and a completely automatic six-station indexing fixture, designed and built by Detroit Broach, these stampings are finished at a rate of 780 per hour. This production output is many times greater than is possible by other methods, and the finish of the broached surface is suitable for final assembly.

This performance record is typical of the production economies of Detroit Broach tooling. Because our engineers specialize in broach tooling only, they are familiar with all types and makes of machines suitable for broaching—as in this case where, to reduce tooling costs, a hydraulic press was selected. Through this knowledge they are able to recommend from all aspects the type of equipment best suited for any broaching operation.

Detroit Broach application engineers are at your disposal to discuss broaching problems. They will gladly supply you with actual cost and production data for your jobs. Write today for our representative to call.

DETROIT *Broach* COMPANY
20201 SHERWOOD AVENUE
DETROIT 12, MICHIGAN



sonnel relations; NORRIS B. MCFARLANE, superintendent of the electric furnace department; EDWIN C. THOMAS, JR., superintendent of the bar mills; and JAMES O. MCDOWELL, superintendent of the sheet mills.

KENNAMETAL, INC., Latrobe, Pa., announces the appointment of CARROLL EDGAR as a representative in the Seattle, Wash., area, with headquarters at 2727 First Ave., South. WILLIAM L. CHAMBERS has been transferred from the midwestern district to the Pittsburgh district office at 600 Grant St., and JOHN D. COOK will replace Mr. Chambers as application engineer in the midwestern district, with headquarters at 9 N. Jefferson St., Chicago, Ill.

VANADIUM-ALLOYS STEEL CO., Latrobe, Pa., has announced the formation of a subsidiary—VANADIUM-ALLOYS STEEL SOCIETA ITALIANA—in cooperation with Elli, Zerboni & Co. of Turin, Italy. The new firm has been established to facilitate international trade in tool steel, now impeded by credit and exchange conditions. Warehouse stocks will be carried in Turin, Milan, and Genoa.

FRANK B. RACKLEY has been made vice-president in charge of sales for the Jessop Steel Co., Washington, Pa. He was formerly general manager of sales. CURTIS A. GORDON, general works manager of the company, has been made vice-president in charge of operations. He was previously superintendent of the Colorado Fuel & Iron Corporation, Wickwire Spencer Steel Division, Buffalo, N. Y.

RAY H. ANDERS has been appointed director of purchases for the Sun Oil Co., Philadelphia 3, Pa., succeeding HENRY THOMAS, who retired on December 1 after thirty-six years of service. Until recently Mr. Anders was manager of the industrial products department.

MOBETH MACHINERY CO., 1109 Grant Bldg., Pittsburgh 19, Pa., has been appointed exclusive representative in the Pennsylvania, West Virginia, and Ohio territory for the HAUSER MACHINE TOOL CORPORATION, manufacturer of jig borers and other precision machinery.

TITEFLEX, INC., 500 Frelinghuysen Ave., Newark 5, N. J., announces the appointment of MANUFACTURERS SALES AGENCY, 523 Brushton Ave., Pittsburgh 21, Pa., as exclusive sales agent for Titeflex products in western Pennsylvania and West Virginia.

INTERSTATE STEEL CO., 308 W. Washington St., Chicago, Ill., has opened an office at 6701 N. Broad St., Philadelphia, Pa., with SAUL BRADBURD in charge.

Paul E. Butzin, Director of Engineering of Delta Mfg. Division, Rockwell Mfg. Co.

Wisconsin

PAUL E. BUTZIN has been appointed director of engineering for the Delta Mfg. Division of the Rockwell Mfg. Co., Milwaukee, Wis. Mr. Butzin was previously works manager of the Milwaukee Gear Co. Prior to going with that concern, he had been connected with Delta for nine years —from 1933 to 1942.

LEE MULLEN has been promoted to the position of vice-president in charge of sales of the Globe Steel Tubes Co., Milwaukee 4, Wis. Prior to his promotion, he was general manager of sales.

Obituary

EUGENE M. MARCHAND, plant engineer of the Sandusky, Ohio, plant of New Departure Division, General Motors Corporation, died on October 20, at the age of forty-seven years, after being stricken while at work. Mr. Marchand joined the Bristol plant of the company in 1919, where he successively held the positions of chief draftsman, assistant plant engineer, and superintendent of heat, light, and power. In 1946, he was transferred to the new Sandusky plant.

* * *

The new passenger cars and trucks and buses produced last year by the automotive industry had a wholesale value in excess of $5,000,000,000, while replacement parts will add $2,250,000,000 more.

Westinghouse Holds Second Materials-Handling Conference

Materials-handling equipment as arteries of modern production was the theme of the second Materials-Handling Machinery Manufacturers Conference held under the sponsorship of the Westinghouse Electric Corporation in Buffalo, N. Y., on November 8 and 9. Sessions were held both at the Hotel Statler and in the Westinghouse motor plant. The various papers presented pointed out that present labor conditions make the adoption of more efficient work-handling a prime necessity.

The technical papers presented at the Hotel Statler were as follows: "A User's Eye View of the Materials-Handling Industry," by E. L. Bailey, staff electrical engineer, Chrysler Corporation; "The Export Market," by D. E. Akins, apparatus division manager, Westinghouse International Co.; "Continuous Flow of Materials and Related Electrical Equipment," by Stanley G. Smith, electrical engineer, Mathews Conveyor Co.; "Conveyors—The Artery of Production," by C. L. Moon, sales engineer, Mechanical Handling Systems; "What Can Be Done for the Operator," by E. C. Rice, vice-president, Whiting Corporation; "Standardization of Motors and Control for Cranes," by C. Brongersma, electrical engineer, Shaw Box Crane Division, Manning, Maxwell & Moore Corporation; "Safety Codes for Materials-Handling Machinery," by E. M. Hays, Crane and Bridge Department, Dravo Corporation; "Bauxite Handling with Adjustable Voltage," by H. G. Dillon, Heyl & Patterson, Inc., and C. B. Risler, Westinghouse Electric Corporation; and "Adjustable-Speed Drives for Materials-Handling Machinery," by M. P. Winther, president, Dynamatic Corporation.

At the Buffalo motor plant, Westinghouse men presented the following papers: "Materials Handling at Buffalo Plant," by T. C. Fockler, assistant general manager; "Special-Duty Cycles," by W. H. Formhals, manager Alternating-Current Development Engineering; "NEMA Performance Standards," by S. F. Henderson, manager Alternating-Current Engineering; "Slow-Motion Movies Aid Control Design," by D. L. Pierce, Control Engineering; "Magnetic Strain Gage," by J. C. Gable, Control Engineering; "Welding Movie," by C. P. Croco, manager, Welding Department; and "Gearing Products," by G. H. McBride, sales manager, Gearing Division.

The principal speaker at the luncheon was Sydney Buckley, president of Shepard Niles Crane & Hoist Corporation; and at the dinner, R. R. Wason, president of Manning, Maxwell & Moore Corporation.

Coming Events

JANUARY 10-14 — Annual meeting and Engineering Display of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel in Detroit, Mich. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

JANUARY 10-14—MATERIALS HANDLING EXPOSITION at Convention Hall, Philadelphia, Pa. Sponsored jointly by the Management and Materials-Handling Divisions of the American Society of Mechanical Engineers and the Material Handling Institute. Further information can be obtained from Clapp & Poliak, Inc., 350 Fifth Ave., New York 1, N. Y.

FEBRUARY 28—MARCH 4—Spring meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Edgewater Beach, Chicago, Ill. Further information can be obtained by addressing the Society at 1916 Race St., Philadelphia 3, Pa.

MARCH 3-5—Fifth annual conference of the American Society of Training Directors at the Hotel Carter, Cleveland, Ohio. Chairman of the Publicity Committee, L. W. Morgan, Care of the Yoder Co., 5500 Walworth, Cleveland, Ohio.

MARCH 8-10—Passenger Car, Body, and Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book-Cadillac Hotel, Detroit, Mich. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

MARCH 28-30—Transportation Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Statler Hotel in Cleveland, Ohio. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

APRIL 8-22 — GERMAN INDUSTRIAL EXHIBIT to be held at the Museum of Science and Industry, 30 Rockefeller Plaza, New York City. Exhibit sponsored and arranged by the Joint Export and Import Agency in Frankfort, Germany.

APRIL 11-13—Aeronautic and Air Transport Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel New Yorker in New York City. Secretary and general manager, John A. C. Warner, 29 W. 39th St., New York 18, N. Y.

APRIL 11-15—Sixth Western Metal Congress and Exposition at the Shrine Auditorium, Los Angeles, Calif. For further information, address National Secretary of American Society for Metals, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

APRIL 25-29 — FOURTH SOUTHERN MACHINERY AND METALS EXPOSITION in the Atlanta Municipal Auditorium, Atlanta, Ga. Michael F. Wiedl, managing director, 267 E. Paces Ferry Road, N.E. Atlanta, Ga.

JUNE 27-JULY 1—Annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Chalfonte-Haddon Hall, Atlantic City, N. J. Headquarters of the Society, 1916 Race St., Philadelphia 3, Pa.

Machining Irregular Contours with Generating Type Broaches

Generating type broaches provide a means of economically machining irregular contours on various types of work. Transmission shifter-fork cams, such as shown in Fig. 1, are a particularly good example. These parts can be quickly broached to very close tolerances by this method.

The broaches used in machining these parts are shown in their holders in Fig. 2. Those at the top are used for the shifter-fork cam seen at the left in Fig. 1, while the broaches at the bottom are employed for the cam at the right in Fig. 1.

In generating type broaches, each successive tooth cuts an increment of the finished form. The broach teeth can be backed off flat to minimize "loading" and to keep the manufacturing cost of the tool at a minimum. These broaches were made by the National Broach & Machine Co., Detroit, Mich.

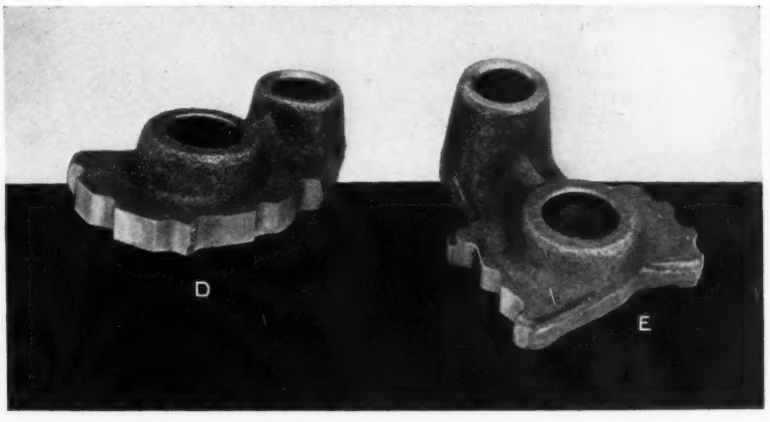


Fig. 1. Transmission Shifter-fork Cams, the Contours of which are Readily Machined by Generating Type Broaches

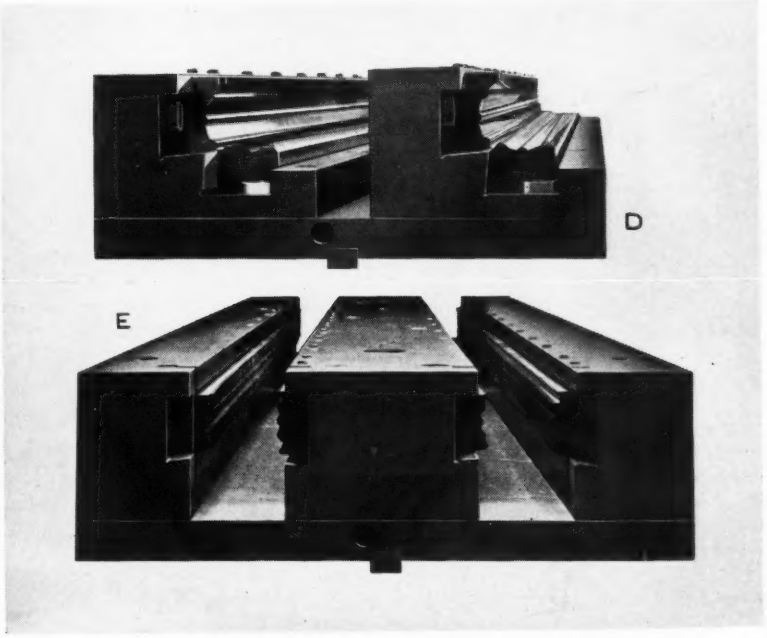


Fig. 2. The Broaches (in Their Respective Holders) Used for Machining the Shifter-fork Cams Illustrated in Fig. 1

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New Books and Publications

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS. By John L. Alden. 252 pages, 5 1/2 by 8 3/4 inches; 120 drawings and diagrams. Published by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, $3.50.

A second edition of this book on industrial exhaust systems, first published in 1939, has been brought out to cover the latest developments on the subject. The text has been completely revised and several new chapters have been added. The book tells the reader how to design, build, or buy an exhaust system that will adequately and economically perform the functions required by law or prescribed by engineers or industrial hygiene specialists. It covers exhaust ventilation; low-pressure pneumatic conveying; design of hoods; piping, and structural details; and the selection of dust separators, centrifugal fans, and axial-flow fans.

BIBLIOGRAPHY OF INDUSTRIAL RADIOLOGY (1945-1948). By Herbert R. Isenburger. 15 pages, 8 1/4 by 11 inches (mimeographed sheets). Published by the St. John X-Ray Laboratory, Califon, N. J. Price, $2.

This is the second supplement to a book on industrial radiology, the second edition of which was published in 1943 by John Wiley & Sons. The first supplement covered the years 1942-1945, and the present supplement continues the list through 1948. The two supplements comprise a complete list of the material published on radiology during the years mentioned, together with the source of the various articles.

DESIGN OF MACHINE ELEMENTS. By M. F. Spotts. 402 pages, 6 by 9 inches. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York City. Price, $6.65.

A knowledge of the principles of mechanical design is a necessary part of every engineer's training. The text of this work on the subject, which is based on twenty years of experience by the author in industry and in the classroom, is so presented as to be of value both to the teacher and to the engineer and designer. The principles of machine design are covered under the following headings: Fundamental Principles; Stress Concentration and Repeated Loading; Theory of Torsion; Springs; Screws; Belts, Brakes, and Clutches; Welded and Riveted Connections; Lubrication; Ball and Roller Bearings; Spur Gears; Helical, Bevel, and Worm Gears; Miscellaneous Machine Elements; Dimensioning and Details; and Engineering Materials. Many illustrative examples are included.

PRACTICAL CONSIDERATIONS IN DIE-CASTING DESIGN. 246 pages, 6 by 9 inches. Published by the New Jersey Zinc Co., 160 Front St., New York 7, N. Y. Price, $3.

The marked interest evidenced in the design of die-castings has led to the publication of this book, which supplements a previous work on the subject, "Die-Casting for Engineers," published in 1942 by the New Jersey Zinc Co. The book just brought out is devoted primarily to a description of actual, specific designs and applications of die-castings made from all alloys now in use. Valuable information on the points involved in their design is also given.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946, of MACHINERY, published monthly at New York 13, N. Y., for October 1, 1948.

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Before me, a Notary Public in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, and July 2, 1946, (section 537, Postal Laws and Regulations), printed on the reverse of this form, to wit:

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Sworn to and subscribed before me this 30th day of September, 1948.

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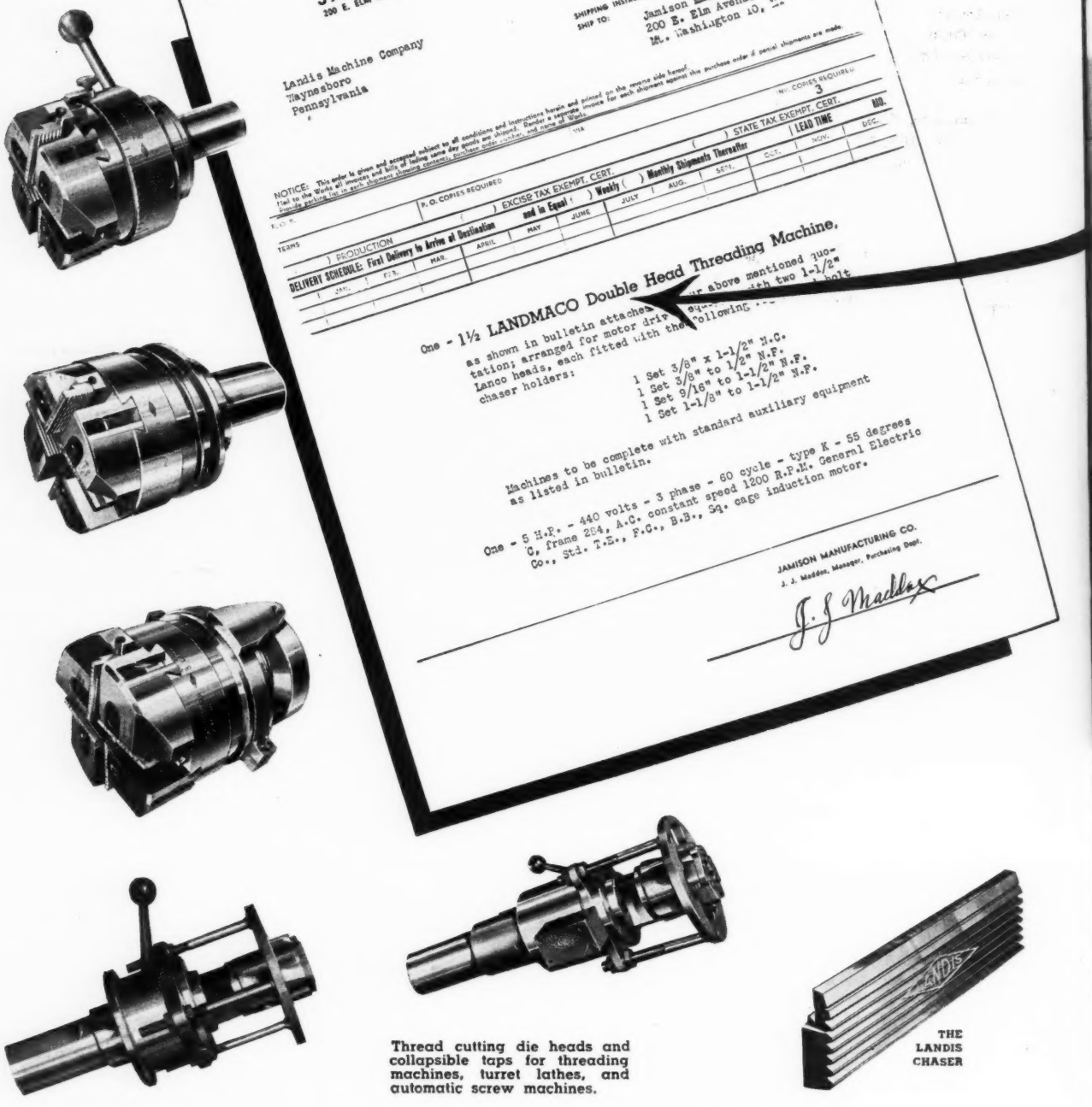
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